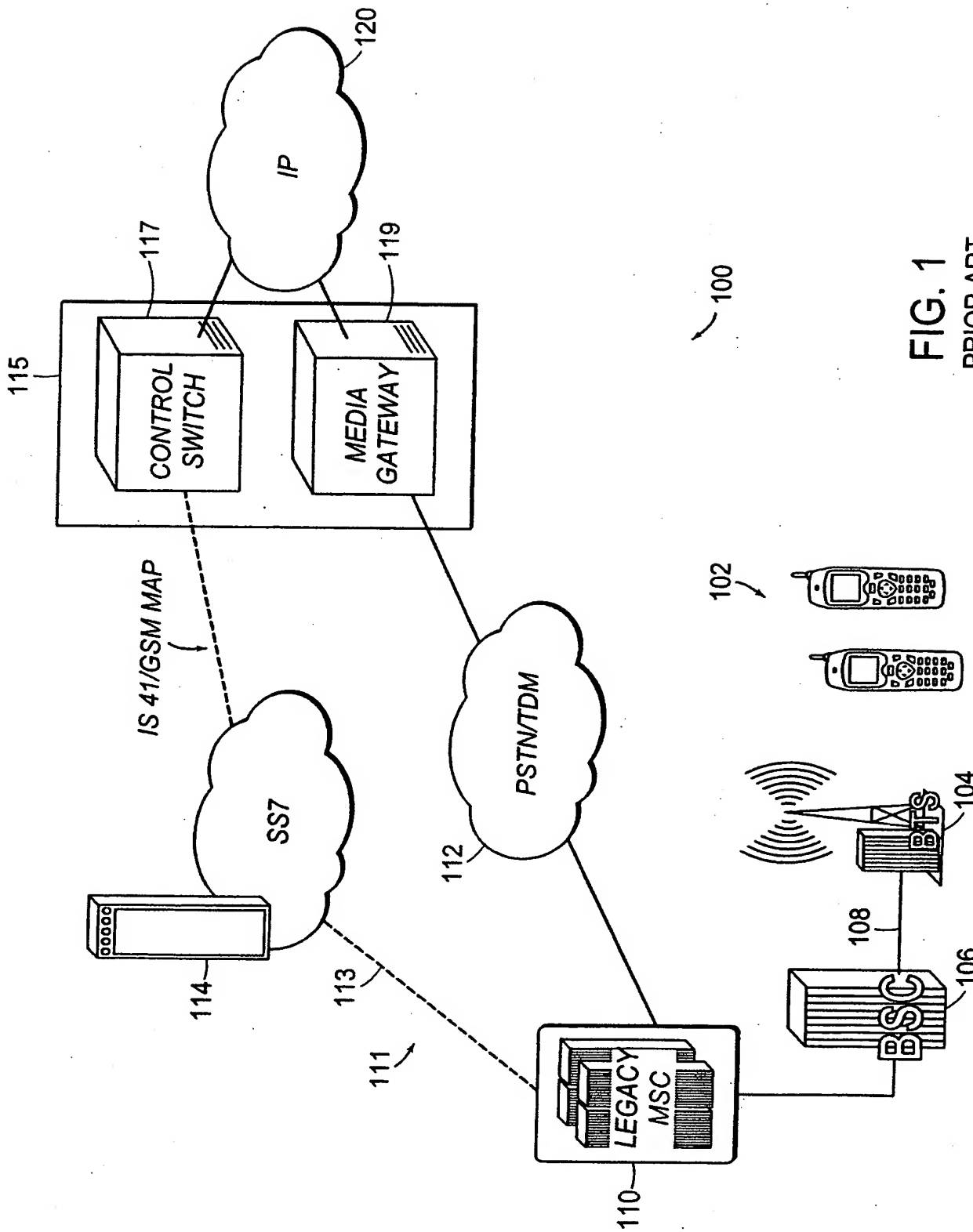


FIG. 1
PRIOR ART

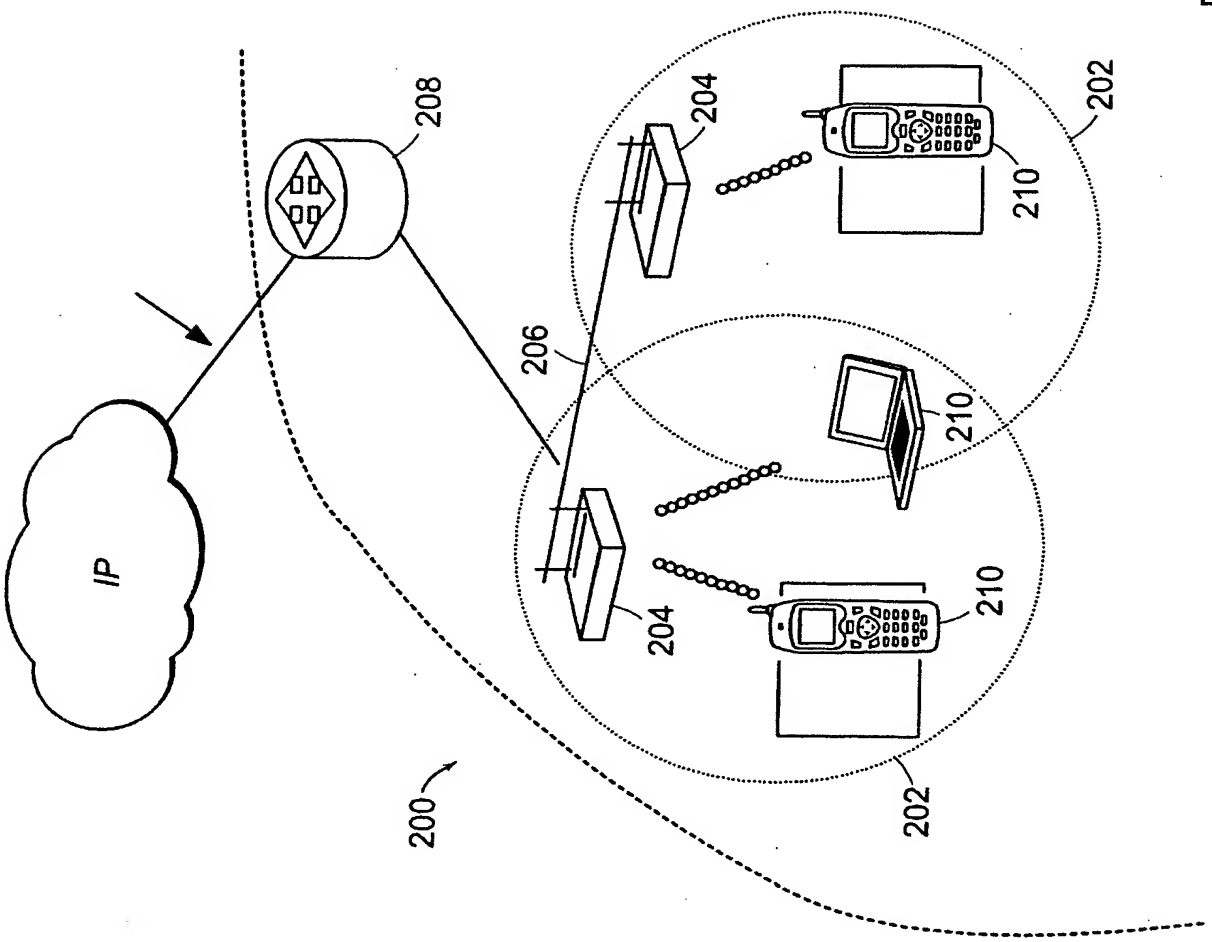


FIG. 2
PRIOR ART

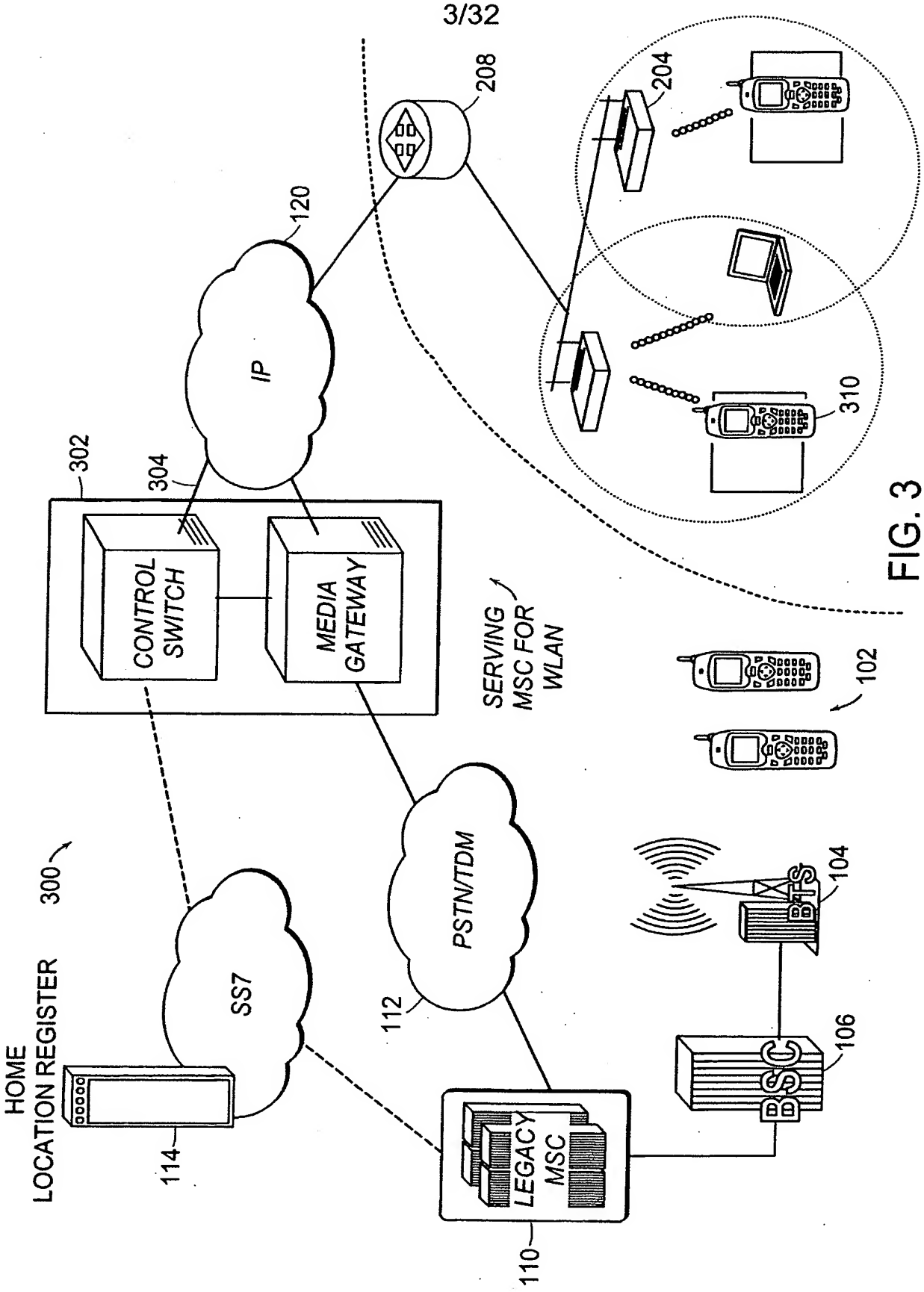

208
204
120
IP
310
302
304
CONTROL SWITCH
MEDIA GATEWAY
SERVING MSC FOR WLAN
102
300
HOME LOCATION REGISTER
SS7
PSTN/TDM
104
BTS
112
106
BSC
114
LEGACY MSC
110

FIG. 3

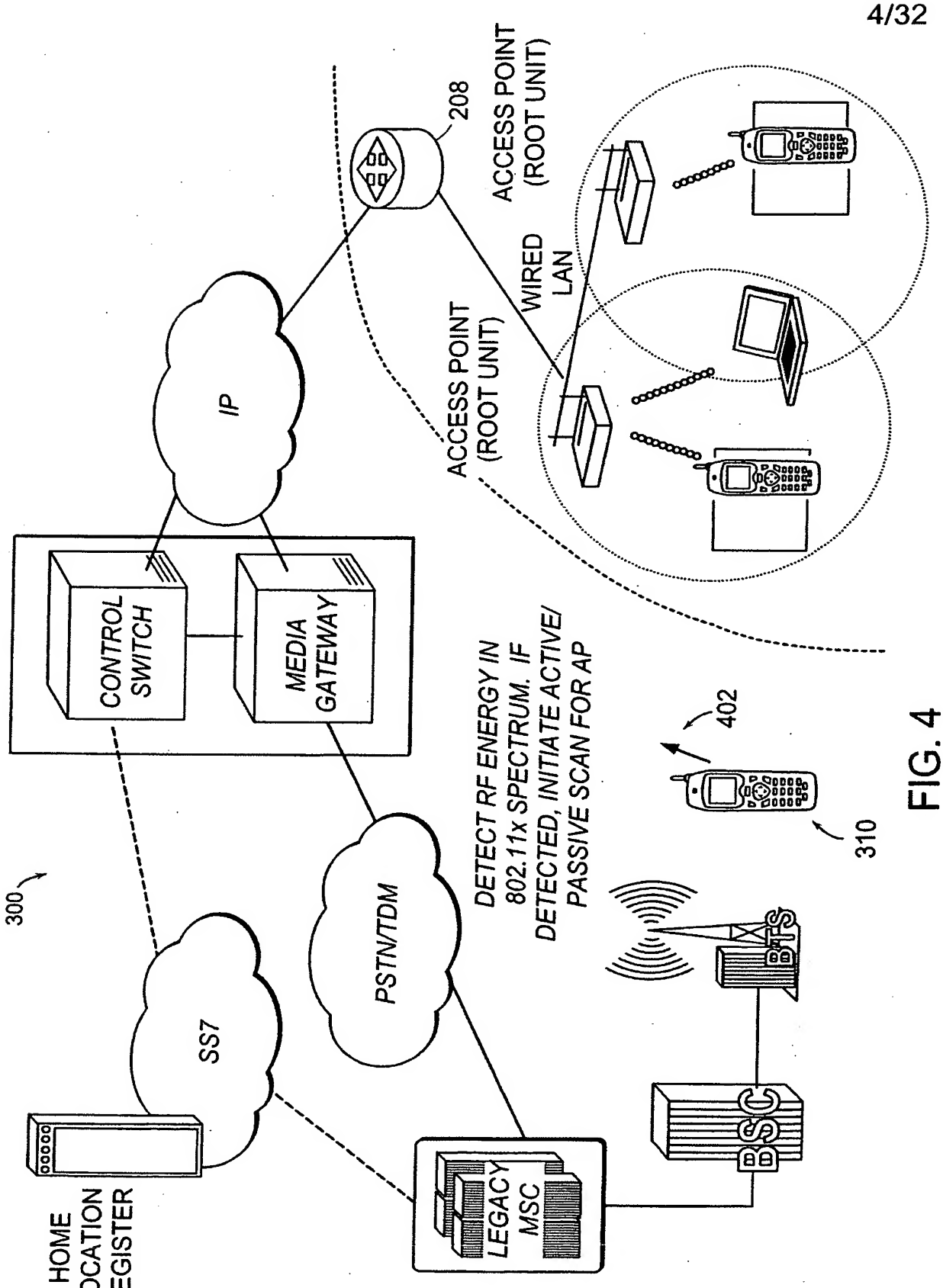

ACCESS POINT (ROOT UNIT)
208
WIRED LAN
ACCESS POINT (ROOT UNIT)
IP
CONTROL SWITCH
MEDIA GATEWAY
DETECT RF ENERGY IN 802.11x SPECTRUM. IF DETECTED, INITIATE ACTIVE/ PASSIVE SCAN FOR AP
402
310
300
PSTN/TDM
SS7
HOME LOCATION REGISTER
LEGACY MSC

FIG. 4

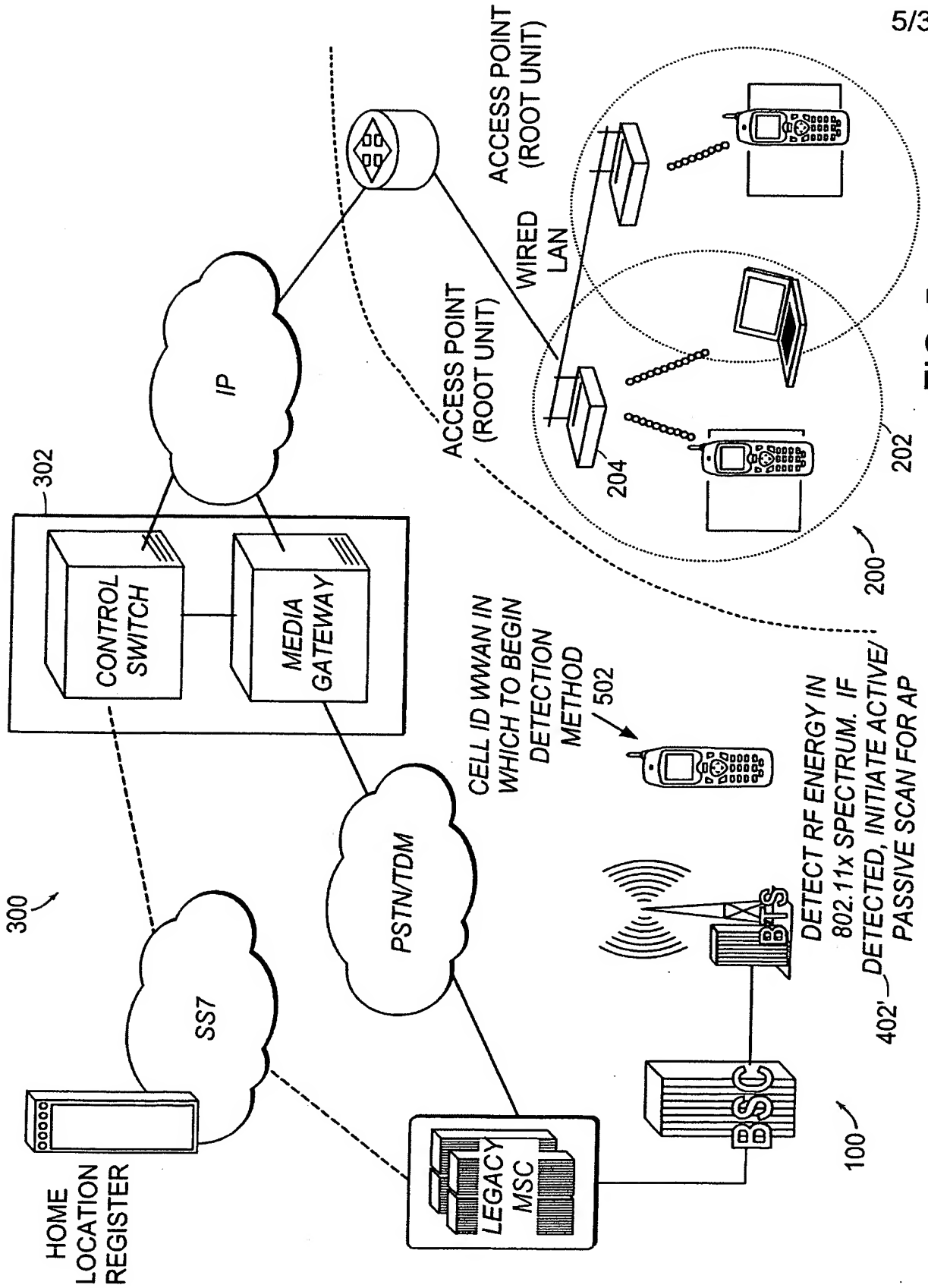

ACCESS POINT (ROOT UNIT)
WIRED LAN
ACCESS POINT (ROOT UNIT)
IP
302
CONTROL SWITCH
MEDIA GATEWAY
204
202
200
CELL ID WWAN IN WHICH TO BEGIN DETECTION METHOD
502
DETECT RF ENERGY IN 802.11x SPECTRUM. IF DETECTED, INITIATE ACTIVE/ PASSIVE SCAN FOR AP
402'
PSTN/TDM
300
SS7
HOME LOCATION REGISTER
LEGACY MSC
100

FIG. 5

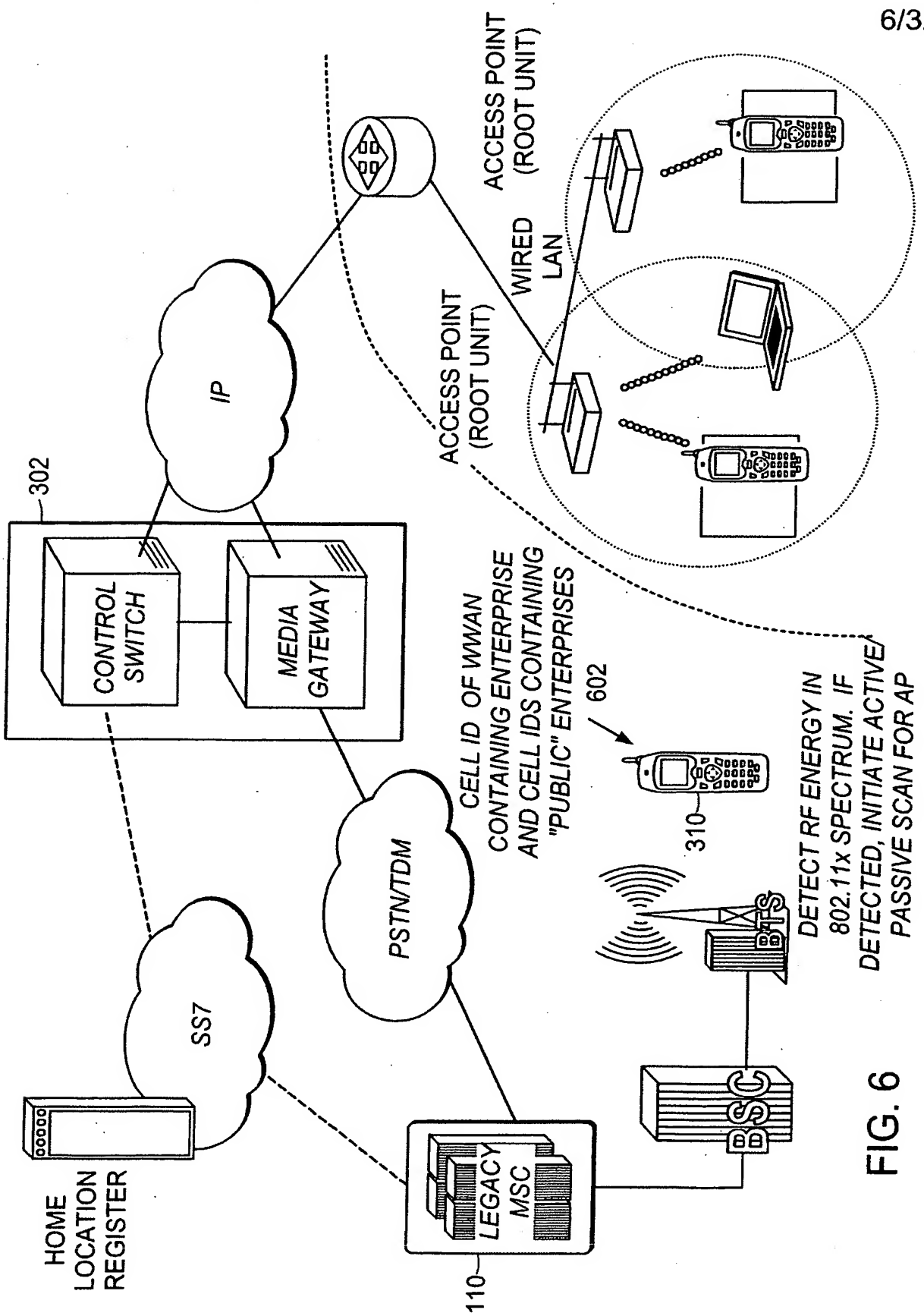
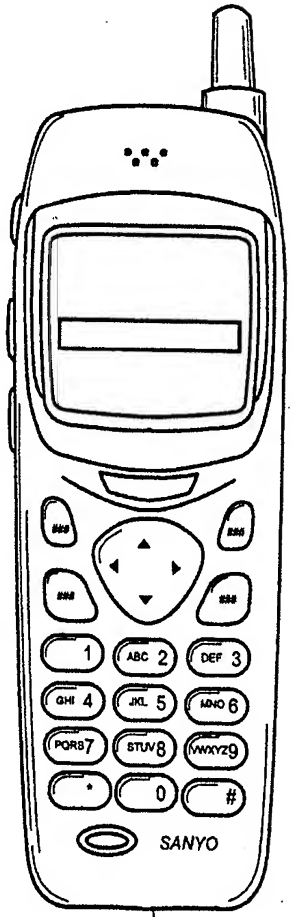

ACCESS POINT (ROOT UNIT)
WIRED LAN
ACCESS POINT (ROOT UNIT)
IP
302
CONTROL SWITCH
MEDIA GATEWAY
CELL ID OF WWAN CONTAINING ENTERPRISE AND CELL IDS CONTAINING "PUBLIC" ENTERPRISES
602
310
PSTN/TDM
SS7
HOME LOCATION REGISTER
LEGACY MSC
110
BTS
DETECT RF ENERGY IN 802.11x SPECTRUM. IF DETECTED, INITIATE ACTIVE/PASSIVE SCAN FOR AP

FIG. 6

CDMA

MULTI-MODE PHONE

IS95/CDMA2000
+
WLAN MODEM
+
VoIP (SIP/RTP/UDP/IP)
+
MOBILITY VIA PREFERRED
EMBODIMENT CLIENT



310

GSM/UMTS

MULTI-MODE PHONE

GSM/UMTS
+
WLAN MODEM
+
VoIP (SIP/RTP/UDP/IP)
+
MOBILITY VIA PREFERRED
EMBODIMENT CLIENT

FIG. 7

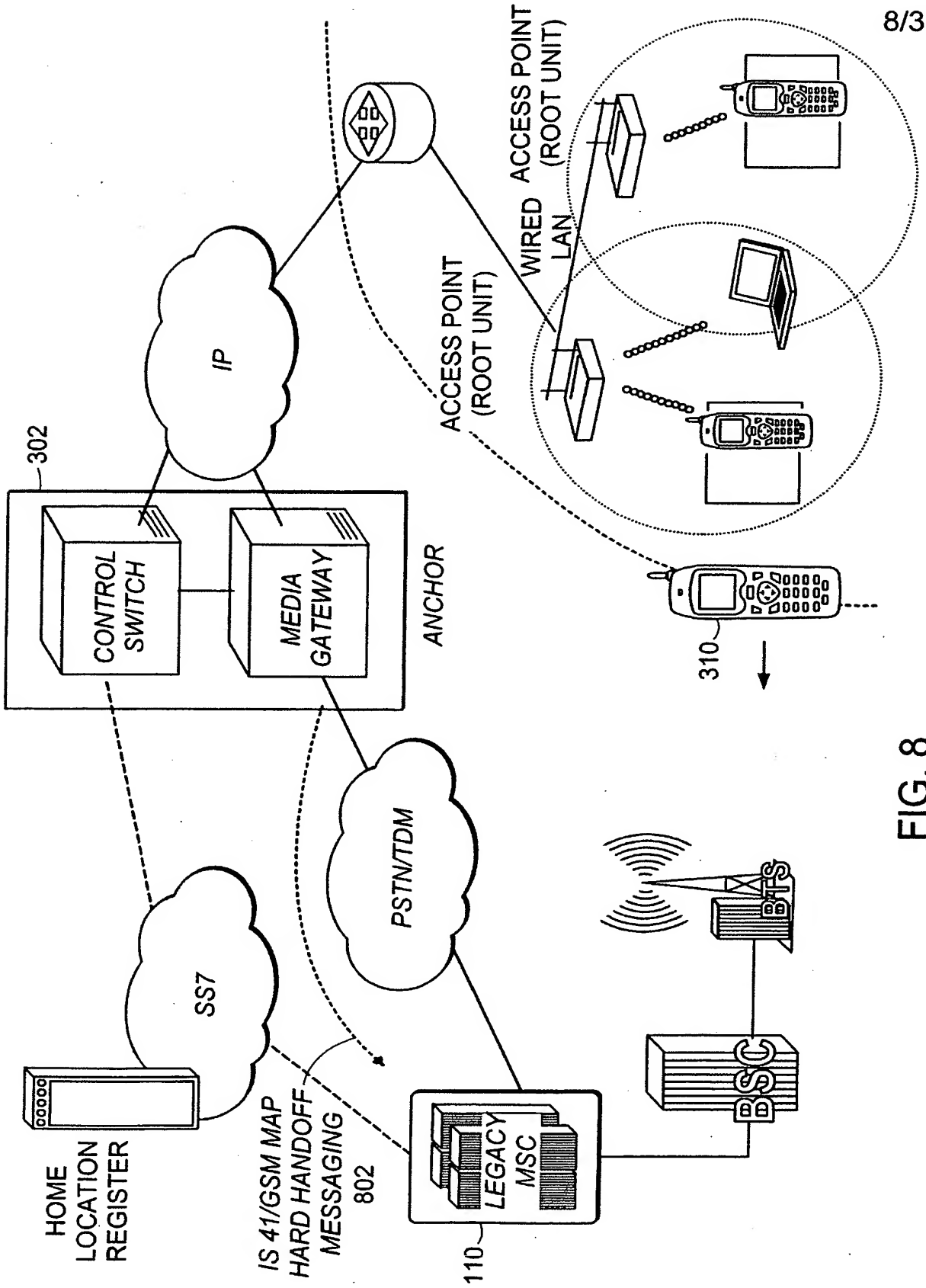

ACCESS POINT (ROOT UNIT)
WIRED LAN
ACCESS POINT (ROOT UNIT)
IP
302
CONTROL SWITCH
MEDIA GATEWAY
ANCHOR
310
PSTN/TDM
SS7
HOME LOCATION REGISTER
IS 41/GSM MAP HARD HANDOFF MESSAGING
802
LEGACY MSC
110

FIG. 8

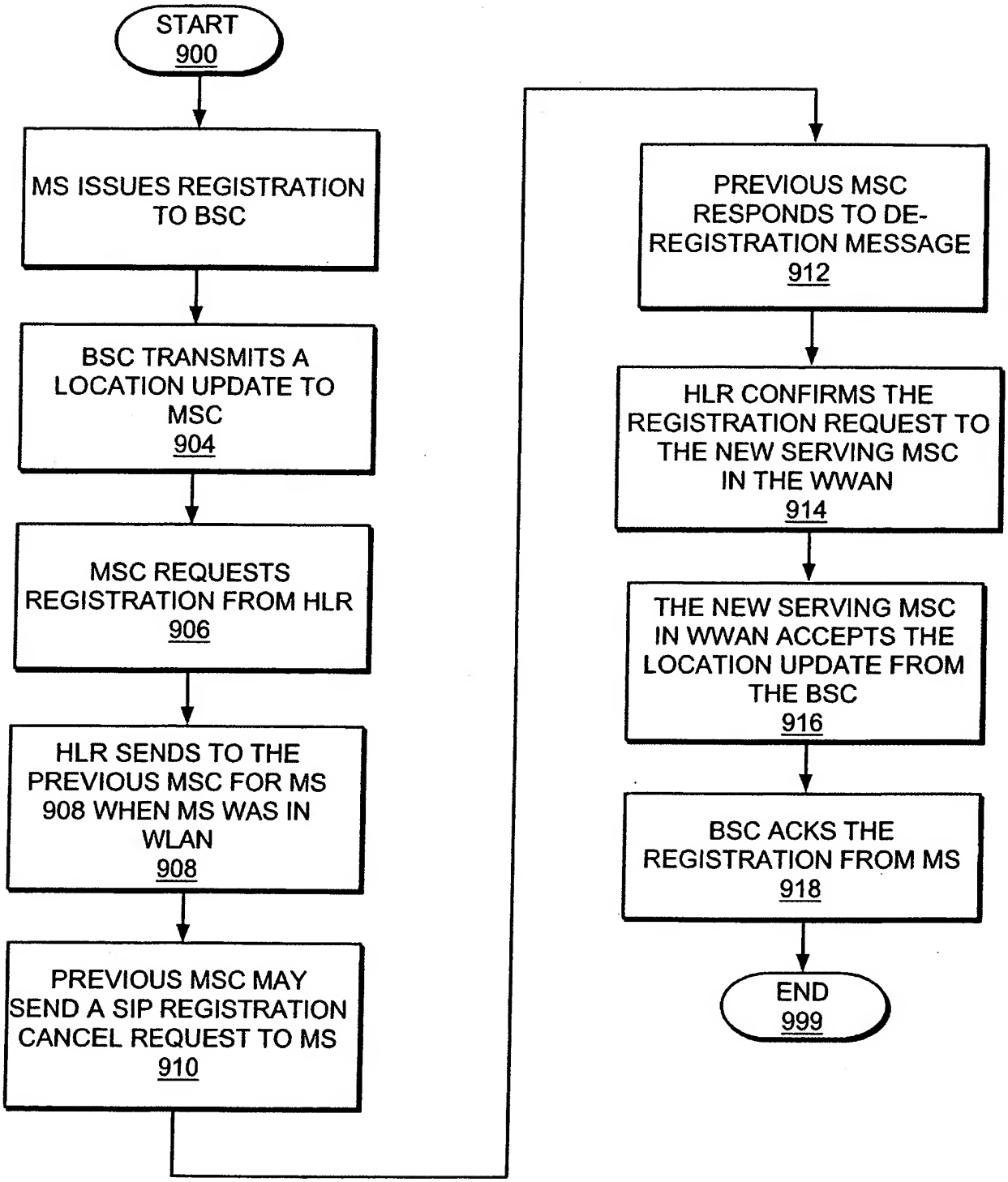

START
900
MS ISSUES REGISTRATION TO BSC
BSC TRANSMITS A LOCATION UPDATE TO MSC
904
MSC REQUESTS REGISTRATION FROM HLR
906
HLR SENDS TO THE PREVIOUS MSC FOR MS 908 WHEN MS WAS IN WLAN
908
PREVIOUS MSC MAY SEND A SIP REGISTRATION CANCEL REQUEST TO MS
910
PREVIOUS MSC RESPONDS TO DE-REGISTRATION MESSAGE
912
HLR CONFIRMS THE REGISTRATION REQUEST TO THE NEW SERVING MSC IN THE WWAN
914
THE NEW SERVING MSC IN WWAN ACCEPTS THE LOCATION UPDATE FROM THE BSC
916
BSC ACKS THE REGISTRATION FROM MS
918
END
999

FIG. 9

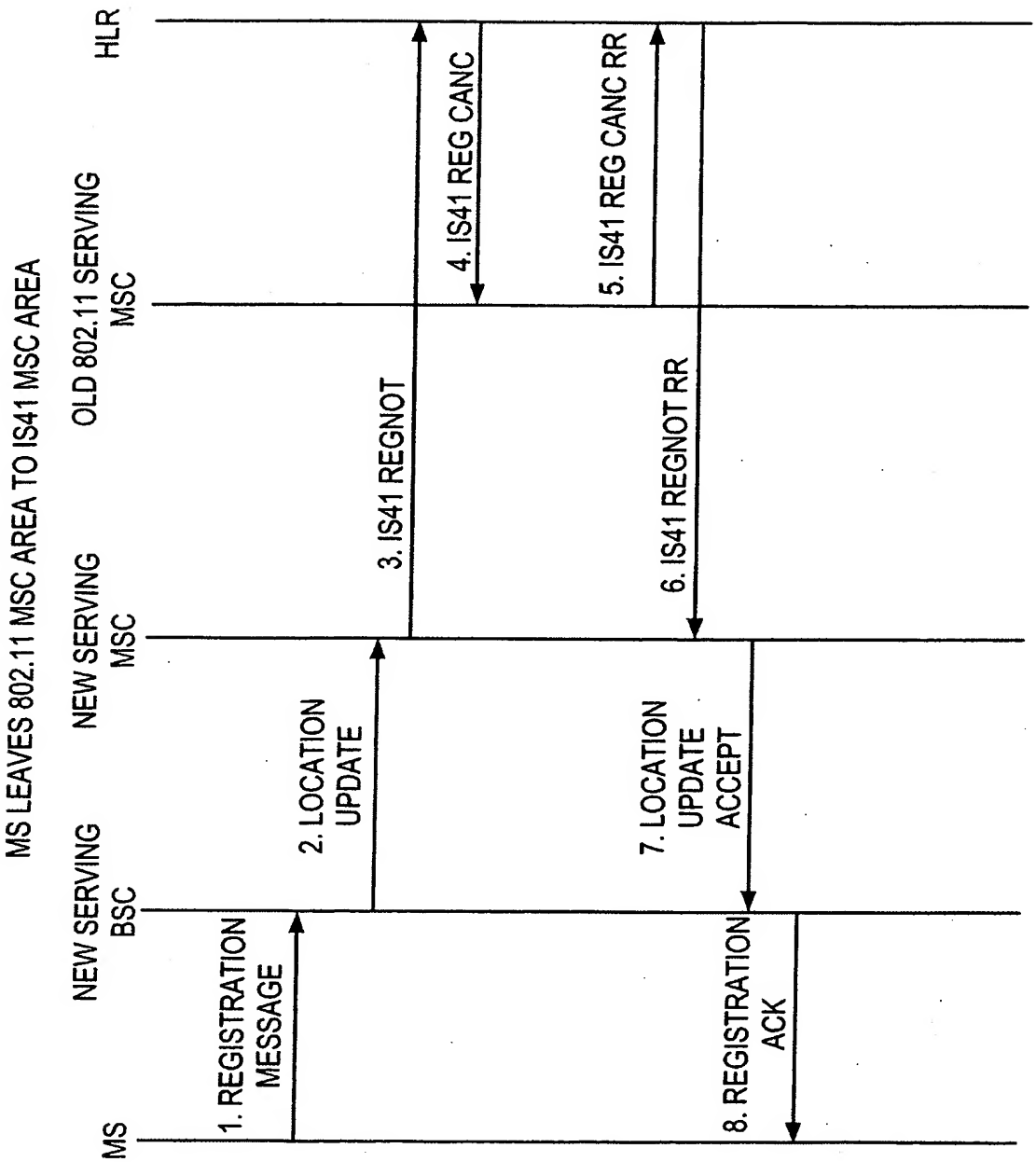

MS LEAVES 802.11 MSC AREA TO IS41 MSC AREA
MS
NEW SERVING BSC
NEW SERVING MSC
OLD 802.11 SERVING MSC
HLR
1. REGISTRATION MESSAGE
2. LOCATION UPDATE
3. IS41 REGNOT
4. IS41 REG CANC
5. IS41 REG CANC RR
6. IS41 REGNOT RR
7. LOCATION UPDATE ACCEPT
8. REGISTRATION ACK

FIG. 10

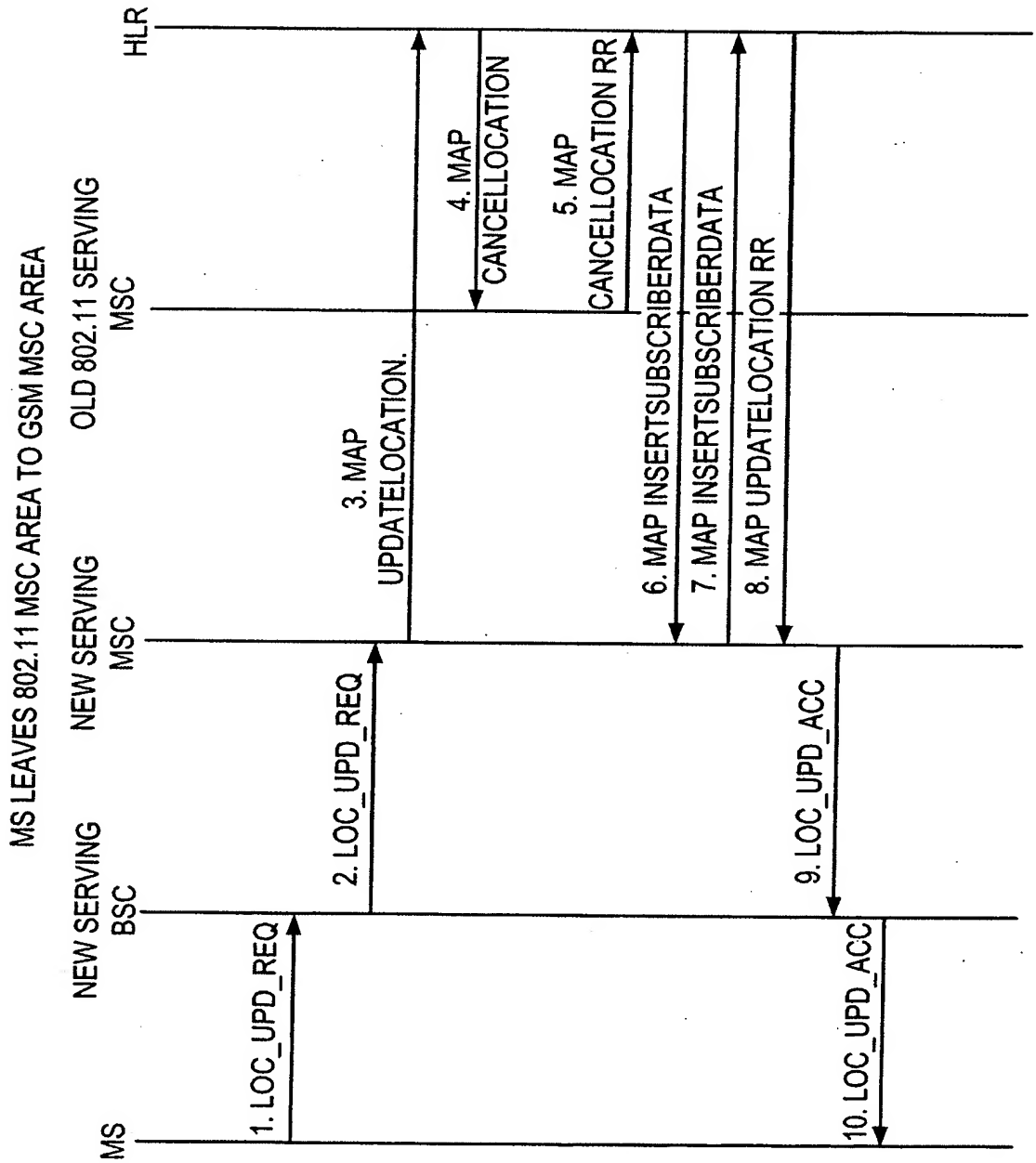

MS LEAVES 802.11 MSC AREA TO GSM MSC AREA
MS
NEW SERVING BSC
NEW SERVING MSC
OLD 802.11 SERVING MSC
HLR
1. LOC_UPD_REQ
2. LOC_UPD_REQ
3. MAP UPDATELOCATION.
4. MAP CANCELLOCATION
5. MAP CANCELLOCATION RR
6. MAP INSERTSUBSCRIBERDATA
7. MAP INSERTSUBSCRIBERDATA
8. MAP UPDATELOCATION RR
9. LOC_UPD_ACC
10. LOC_UPD_ACC

FIG. 11

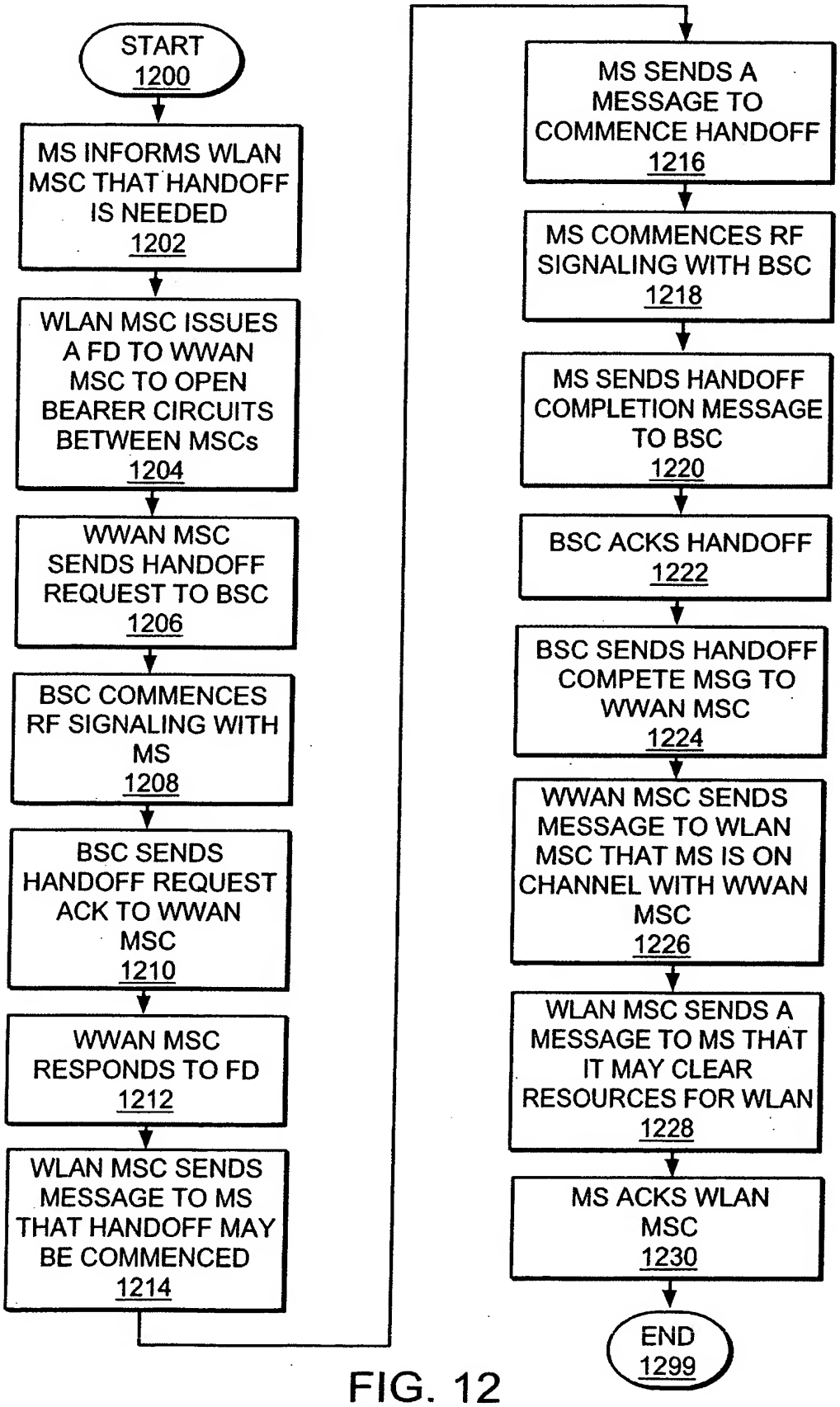

START
1200
MS INFORMS WLAN MSC THAT HANDOFF IS NEEDED
1202
WLAN MSC ISSUES A FD TO WWAN MSC TO OPEN BEARER CIRCUITS BETWEEN MSCs
1204
WWAN MSC SENDS HANDOFF REQUEST TO BSC
1206
BSC COMMENCES RF SIGNALING WITH MS
1208
BSC SENDS HANDOFF REQUEST ACK TO WWAN MSC
1210
WWAN MSC RESPONDS TO FD
1212
WLAN MSC SENDS MESSAGE TO MS THAT HANDOFF MAY BE COMMENCED
1214
MS SENDS A MESSAGE TO COMMENCE HANDOFF
1216
MS COMMENCES RF SIGNALING WITH BSC
1218
MS SENDS HANDOFF COMPLETION MESSAGE TO BSC
1220
BSC ACKS HANDOFF
1222
BSC SENDS HANDOFF COMPETE MSG TO WWAN MSC
1224
WWAN MSC SENDS MESSAGE TO WLAN MSC THAT MS IS ON CHANNEL WITH WWAN MSC
1226
WLAN MSC SENDS A MESSAGE TO MS THAT IT MAY CLEAR RESOURCES FOR WLAN
1228
MS ACKS WLAN MSC
1230
END
1299

FIG. 12

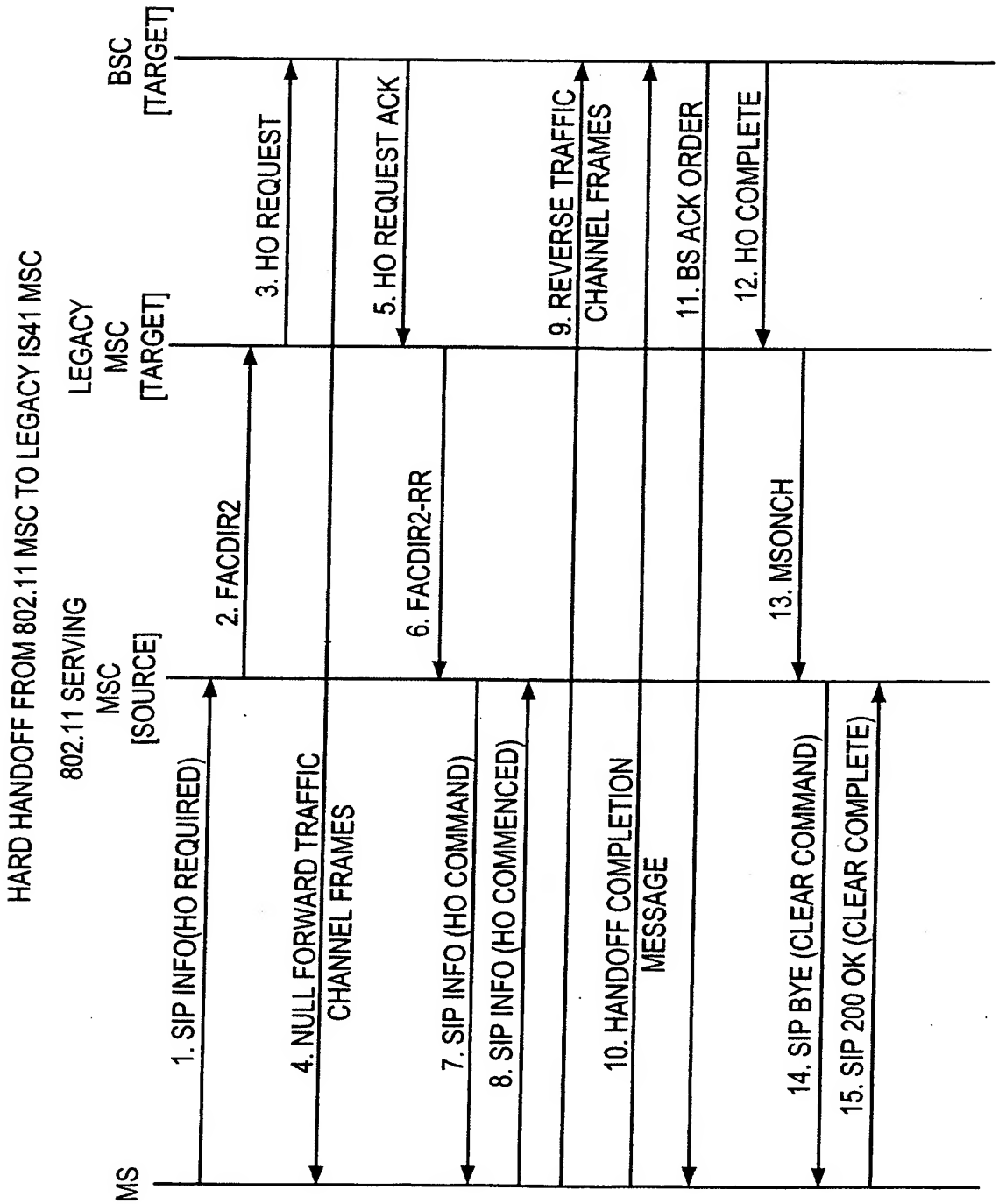

HARD HANDOFF FROM 802.11 MSC TO LEGACY IS41 MSC
MS
802.11 SERVING MSC [SOURCE]
LEGACY MSC [TARGET]
BSC [TARGET]
1. SIP INFO(HO REQUIRED)
2. FACDIR2
3. HO REQUEST
4. NULL FORWARD TRAFFIC CHANNEL FRAMES
5. HO REQUEST ACK
6. FACDIR2-RR
7. SIP INFO (HO COMMAND)
8. SIP INFO (HO COMMENCED)
9. REVERSE TRAFFIC CHANNEL FRAMES
10. HANDOFF COMPLETION MESSAGE
11. BS ACK ORDER
12. HO COMPLETE
13. MSONCH
14. SIP BYE (CLEAR COMMAND)
15. SIP 200 OK (CLEAR COMPLETE)

FIG. 13

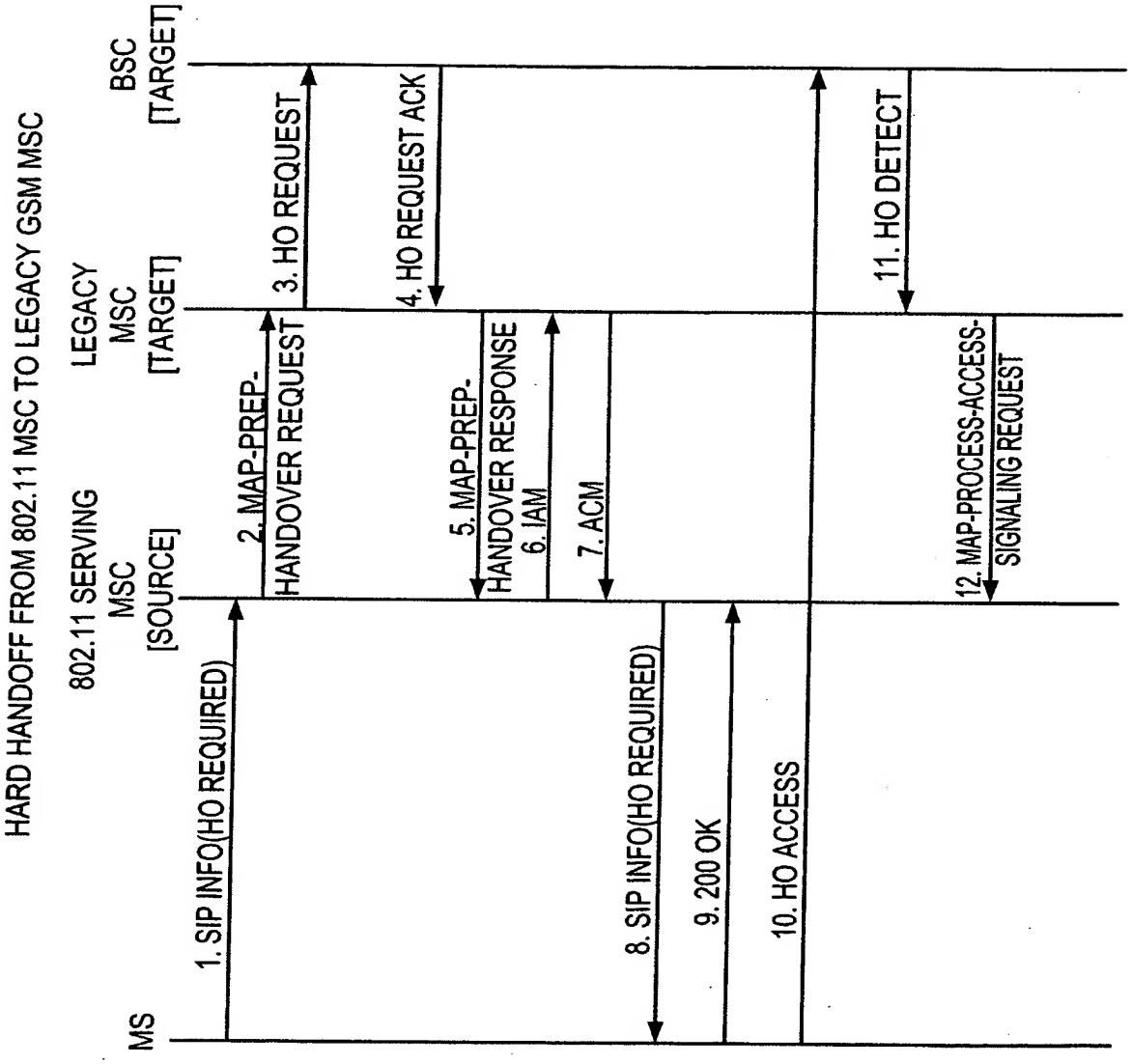


FIG. 14A

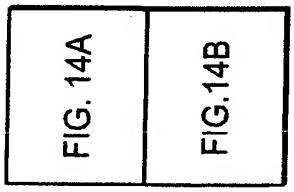


FIG. 14

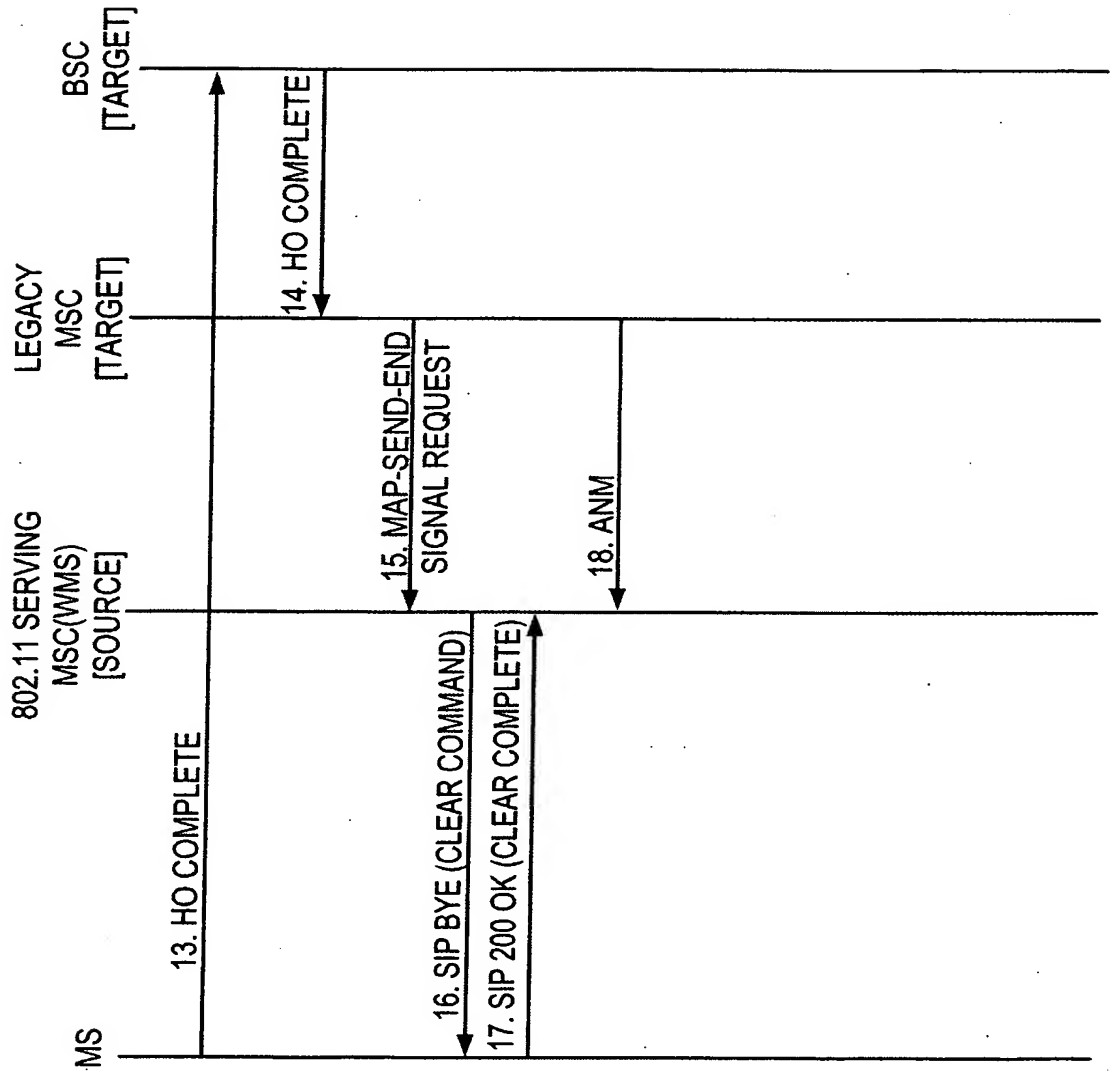

BSC [TARGET]
LEGACY MSC [TARGET]
802.11 SERVING MSC(WMS) [SOURCE]
MS
14. HO COMPLETE
15. MAP-SEND-END SIGNAL REQUEST
18. ANM
13. HO COMPLETE
16. SIP BYE (CLEAR COMMAND)
17. SIP 200 OK (CLEAR COMPLETE)

FIG. 14B

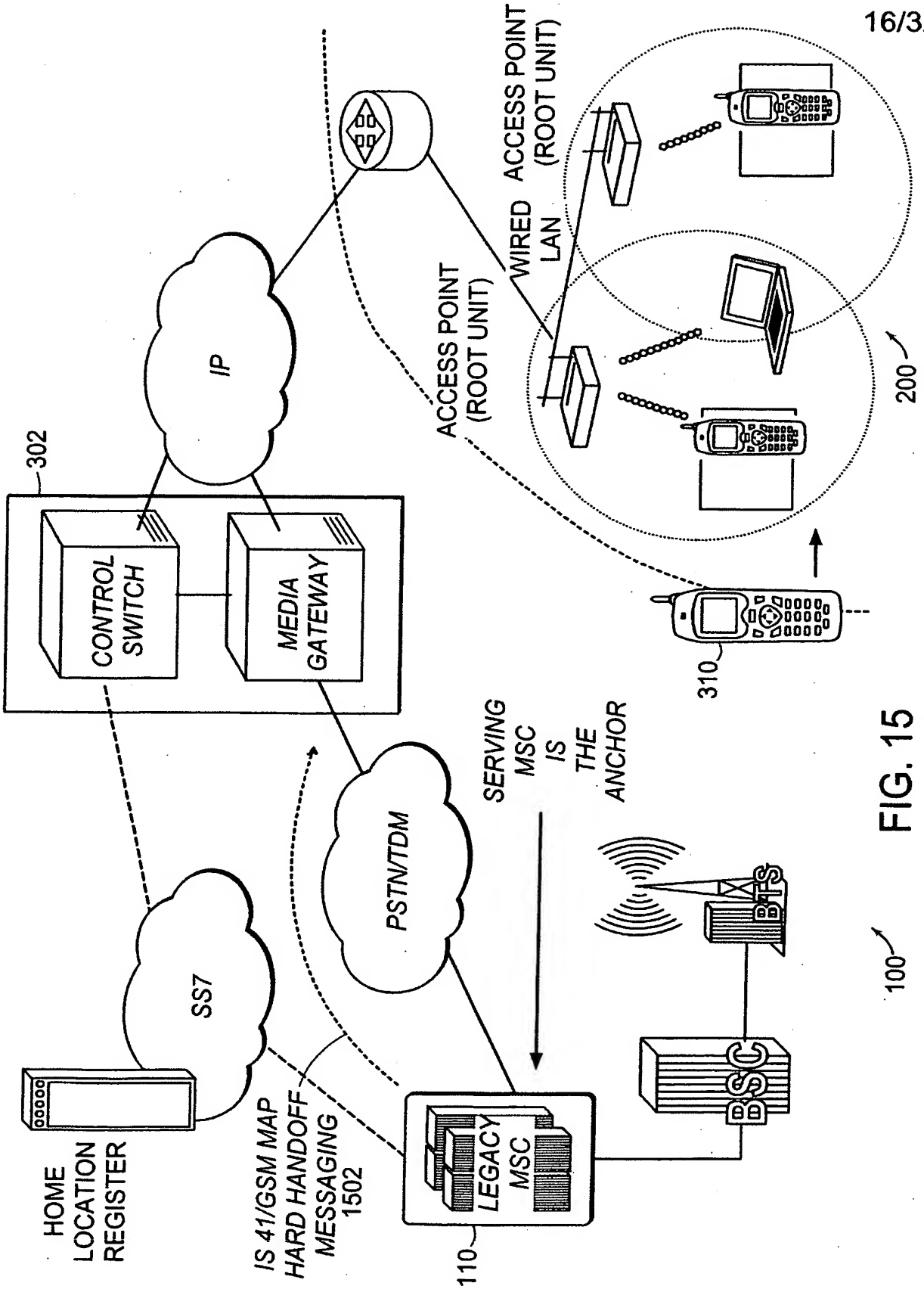

ACCESS POINT (ROOT UNIT)
WIRED LAN
ACCESS POINT (ROOT UNIT)
IP
302
CONTROL SWITCH
MEDIA GATEWAY
200
310
SERVING MSC IS THE ANCHOR
PSTN/TDM
SS7
HOME LOCATION REGISTER
IS 41/GSM MAP HARD HANDOFF MESSAGING 1502
LEGACY MSC
110
100

FIG. 15

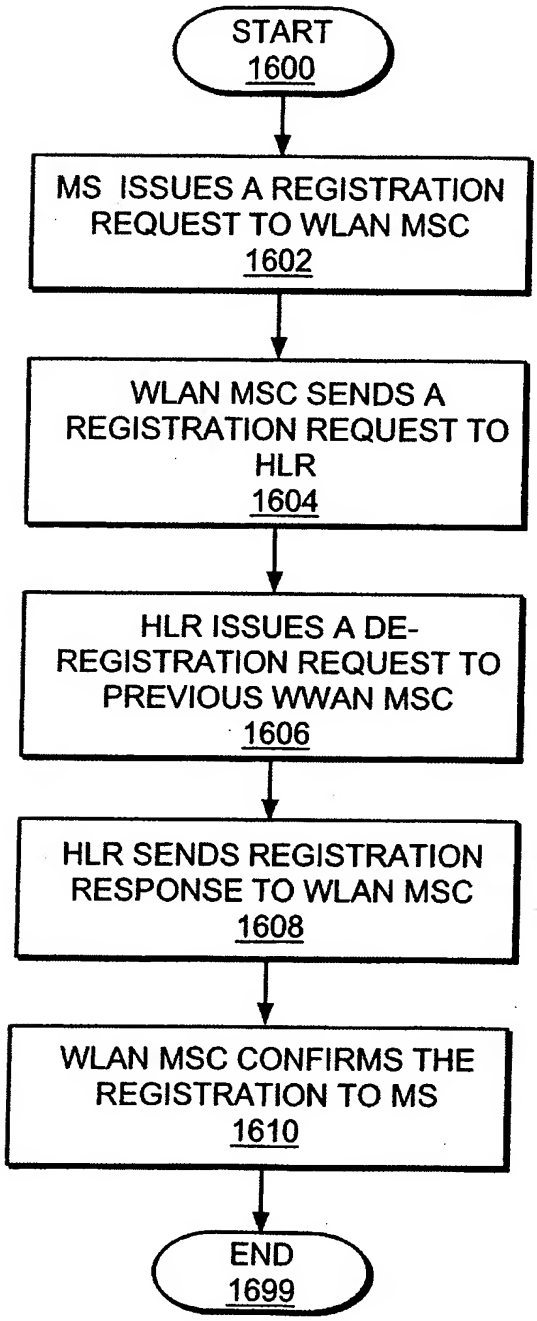

START
1600
MS ISSUES A REGISTRATION REQUEST TO WLAN MSC
1602
WLAN MSC SENDS A REGISTRATION REQUEST TO HLR
1604
HLR ISSUES A DE-REGISTRATION REQUEST TO PREVIOUS WWAN MSC
1606
HLR SENDS REGISTRATION RESPONSE TO WLAN MSC
1608
WLAN MSC CONFIRMS THE REGISTRATION TO MS
1610
END
1699

FIG. 16

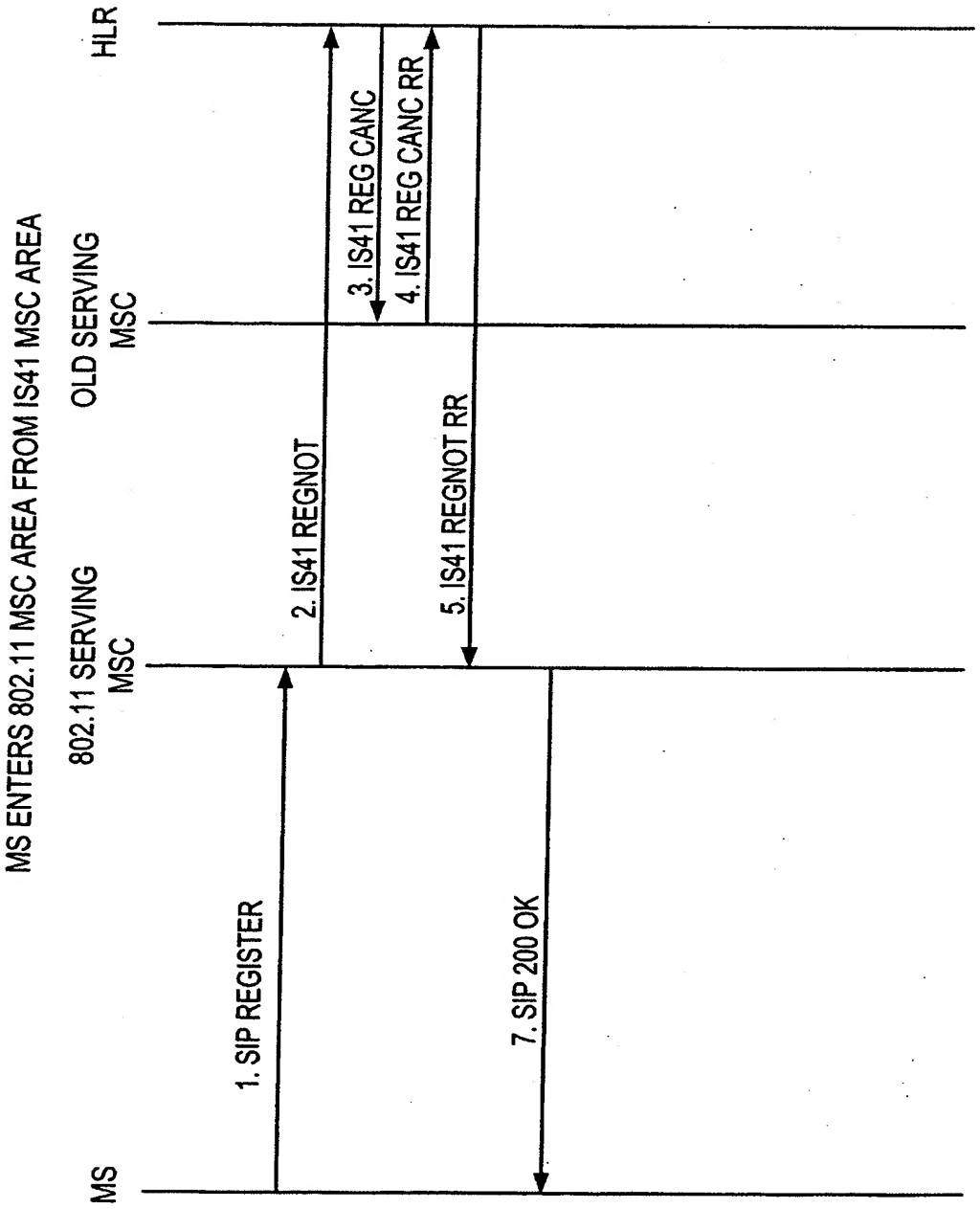

MS ENTERS 802.11 MSC AREA FROM IS41 MSC AREA
MS
802.11 SERVING MSC
OLD SERVING MSC
HLR
1. SIP REGISTER
2. IS41 REGNOT
3. IS41 REG CANC
4. IS41 REG CANC RR
5. IS41 REGNOT RR
7. SIP 200 OK

FIG. 17

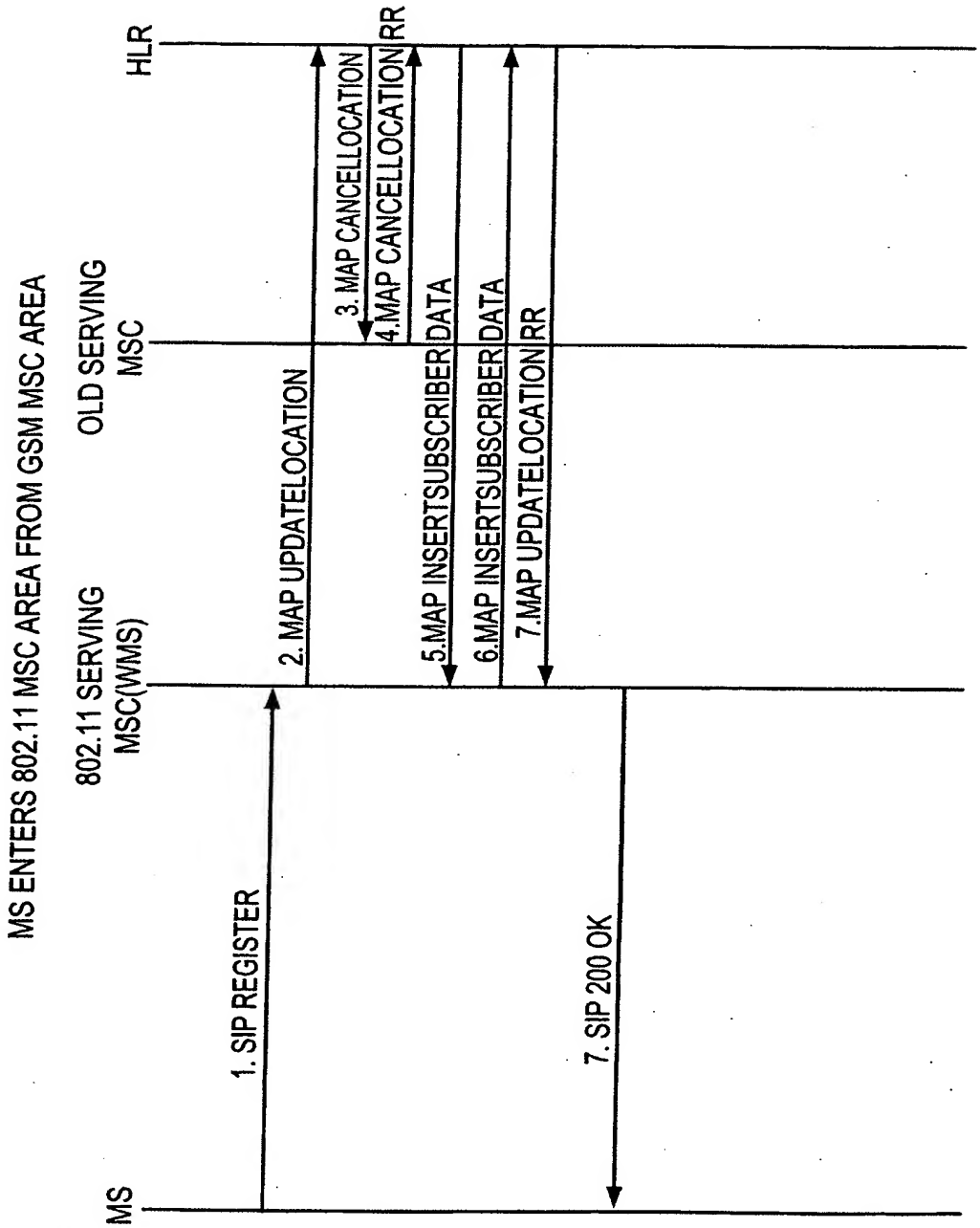

MS ENTERS 802.11 MSC AREA FROM GSM MSC AREA
802.11 SERVING MSC(WMS)
OLD SERVING MSC
HLR
MS
1. SIP REGISTER
2. MAP UPDATELOCATION
3. MAP CANCELLOCATION
4.MAP CANCELLOCATION RR
5.MAP INSERTSUBSCRIBER DATA
6.MAP INSERTSUBSCRIBER DATA
7.MAP UPDATELOCATION RR
7. SIP 200 OK

FIG. 18

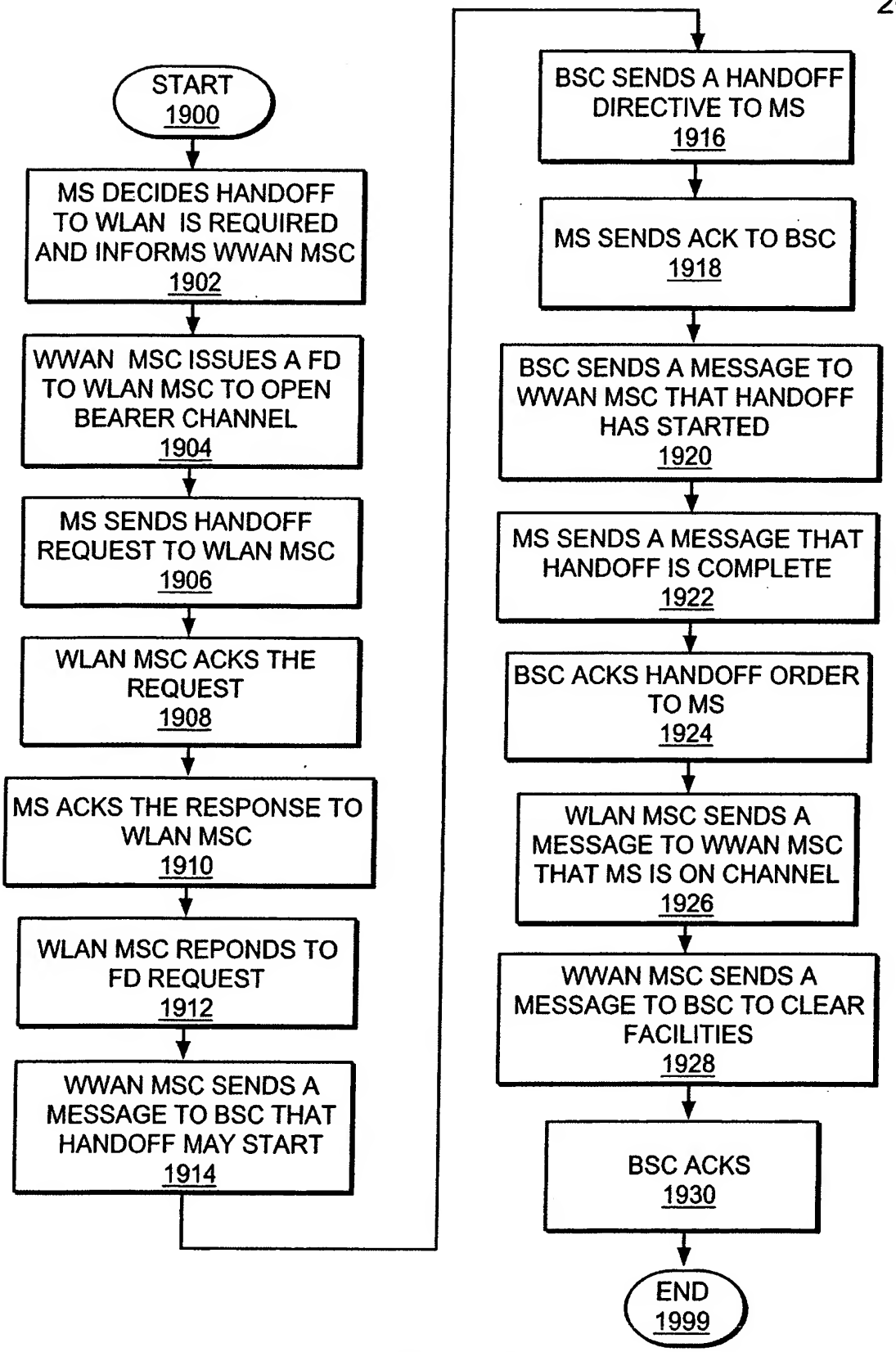

START
1900
MS DECIDES HANDOFF TO WLAN IS REQUIRED AND INFORMS WWAN MSC
1902
WWAN MSC ISSUES A FD TO WLAN MSC TO OPEN BEARER CHANNEL
1904
MS SENDS HANDOFF REQUEST TO WLAN MSC
1906
WLAN MSC ACKS THE REQUEST
1908
MS ACKS THE RESPONSE TO WLAN MSC
1910
WLAN MSC REPONDS TO FD REQUEST
1912
WWAN MSC SENDS A MESSAGE TO BSC THAT HANDOFF MAY START
1914
BSC SENDS A HANDOFF DIRECTIVE TO MS
1916
MS SENDS ACK TO BSC
1918
BSC SENDS A MESSAGE TO WWAN MSC THAT HANDOFF HAS STARTED
1920
MS SENDS A MESSAGE THAT HANDOFF IS COMPLETE
1922
BSC ACKS HANDOFF ORDER TO MS
1924
WLAN MSC SENDS A MESSAGE TO WWAN MSC THAT MS IS ON CHANNEL
1926
WWAN MSC SENDS A MESSAGE TO BSC TO CLEAR FACILITIES
1928
BSC ACKS
1930
END
1999

FIG. 19

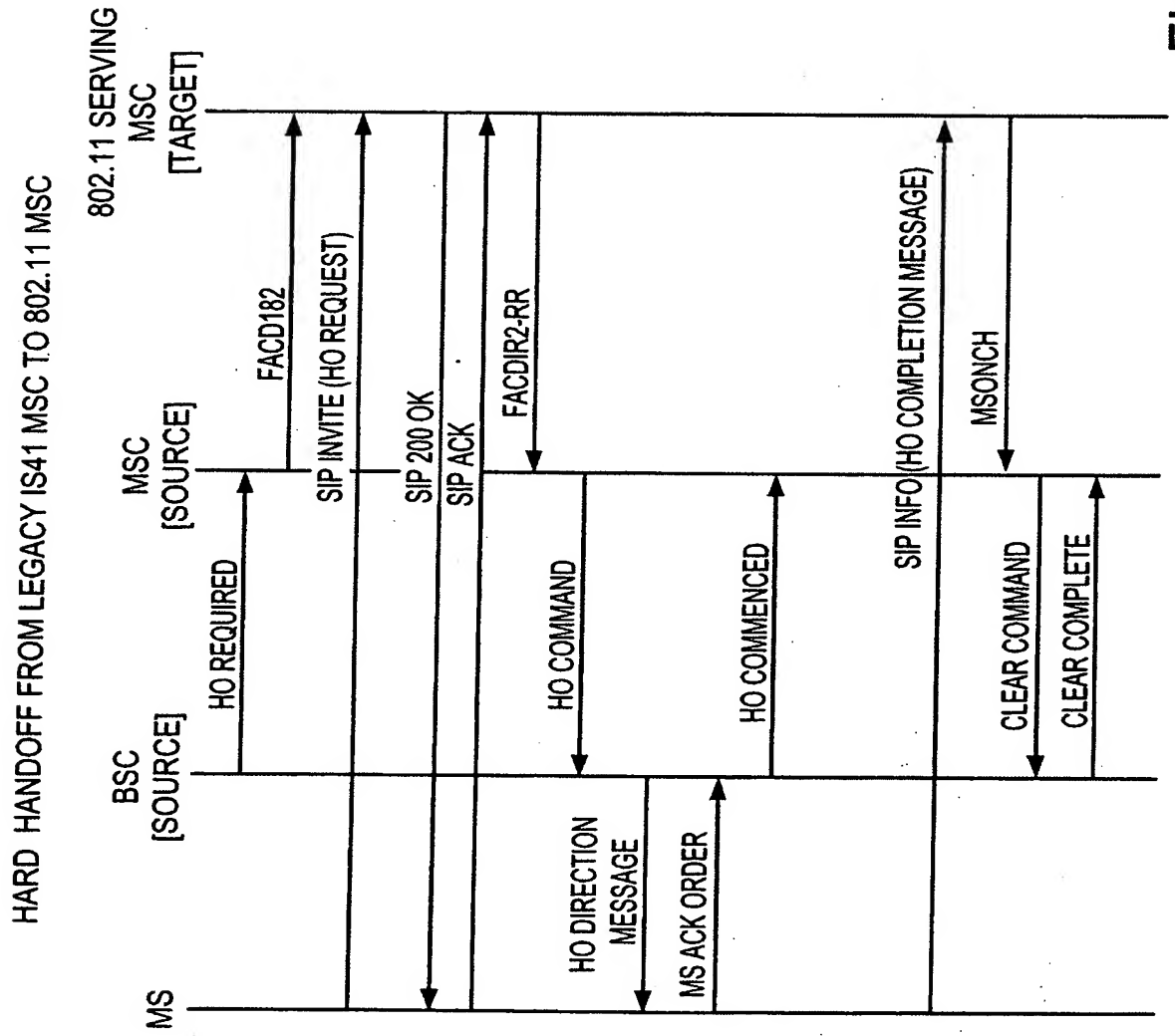

HARD HANDOFF FROM LEGACY IS41 MSC TO 802.11 MSC
MS
BSC [SOURCE]
MSC [SOURCE]
802.11 SERVING MSC [TARGET]
HO REQUIRED
FACD182
SIP INVITE (HO REQUEST)
SIP 200 OK
SIP ACK
FACDIR2-RR
HO COMMAND
HO DIRECTION MESSAGE
MS ACK ORDER
HO COMMENCED
SIP INFO(HO COMPLETION MESSAGE)
MSONCH
CLEAR COMMAND
CLEAR COMPLETE

FIG. 20

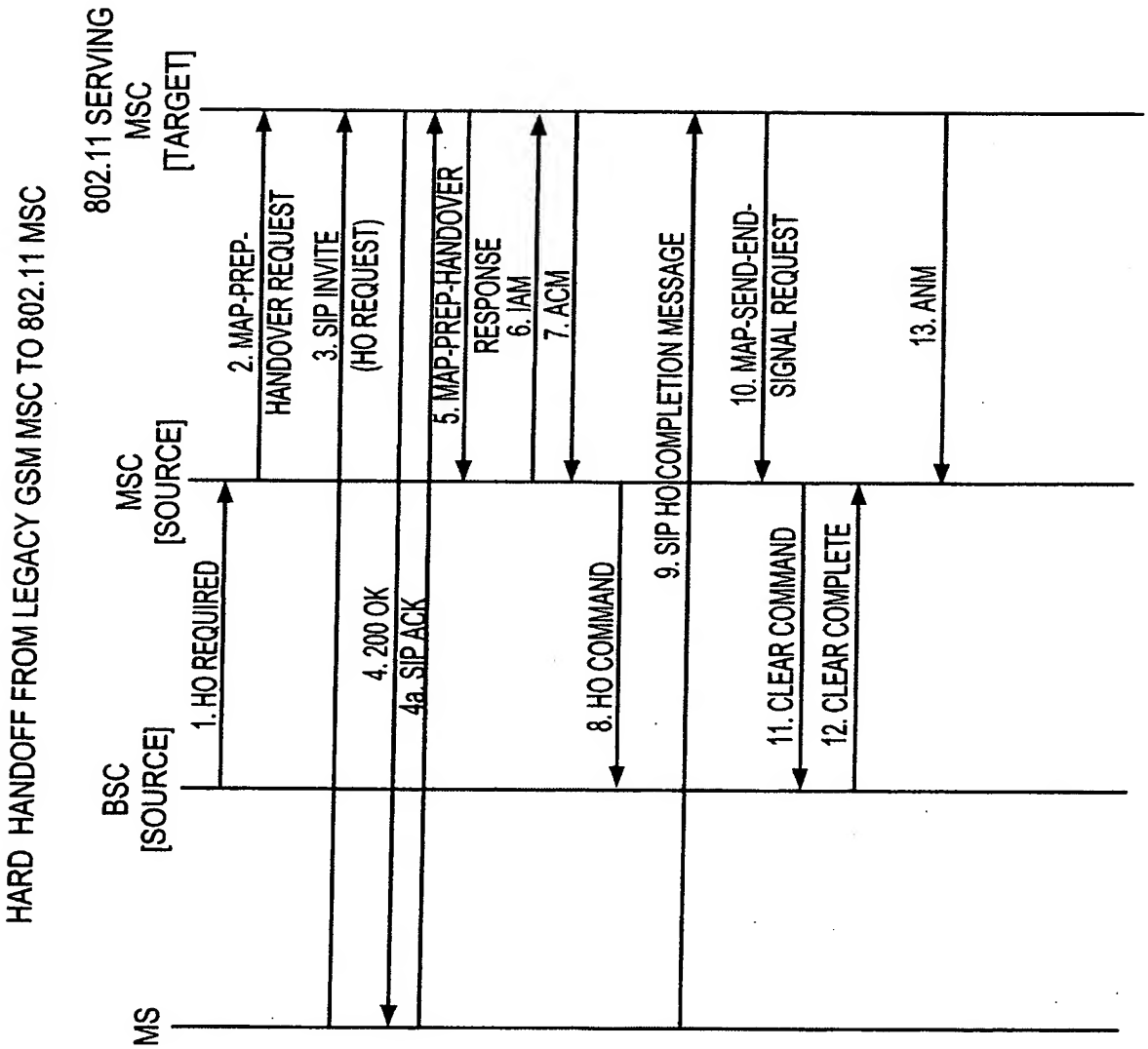

HARD HANDOFF FROM LEGACY GSM MSC TO 802.11 MSC
MS
BSC [SOURCE]
MSC [SOURCE]
802.11 SERVING MSC [TARGET]
1. HO REQUIRED
2. MAP-PREP-HANDOVER REQUEST
3. SIP INVITE (HO REQUEST)
4. 200 OK
4a. SIP ACK
5. MAP-PREP-HANDOVER RESPONSE
6. IAM
7. ACM
8. HO COMMAND
9. SIP HO COMPLETION MESSAGE
10. MAP-SEND-END-SIGNAL REQUEST
11. CLEAR COMMAND
12. CLEAR COMPLETE
13. ANM

FIG. 21

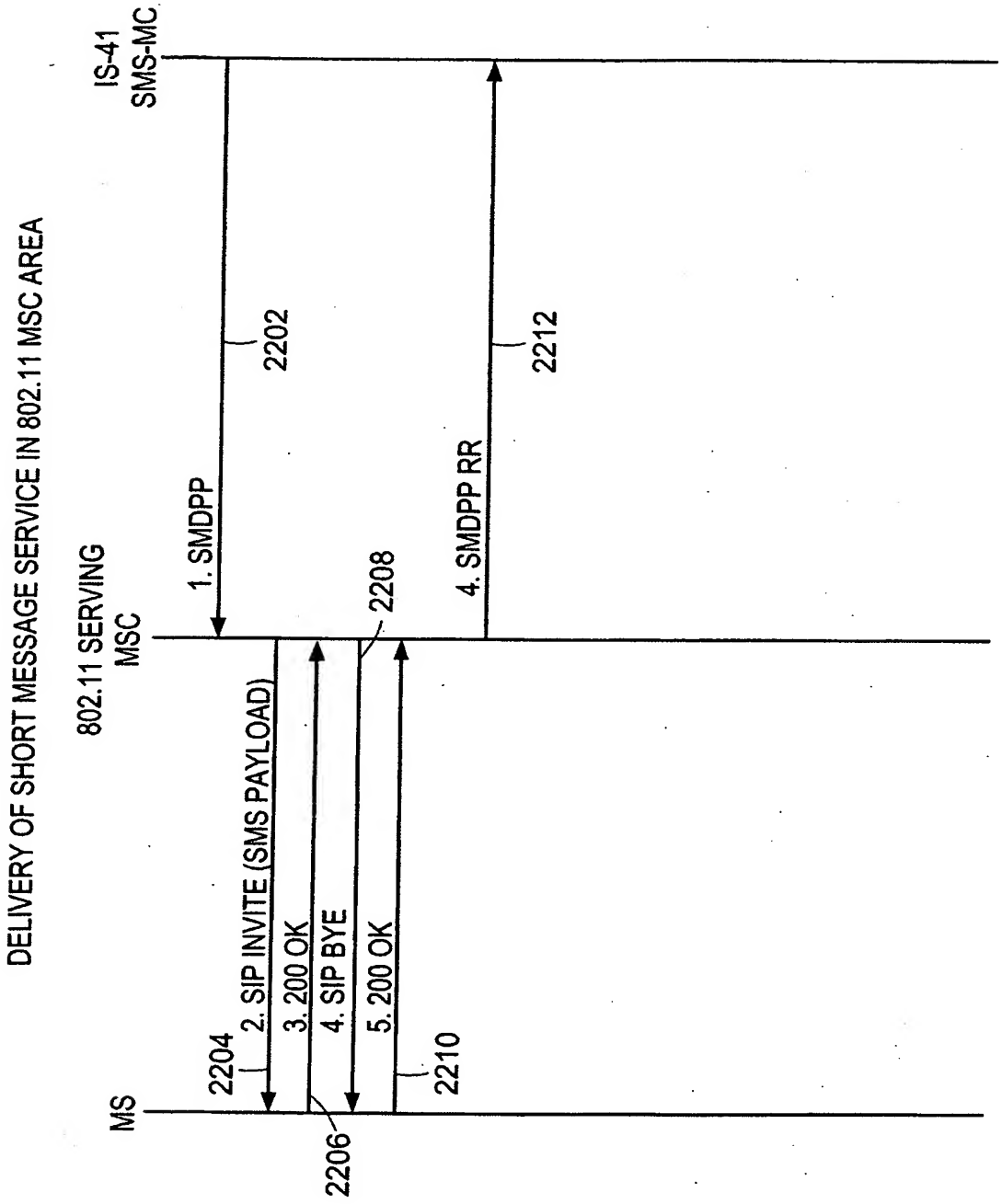

DELIVERY OF SHORT MESSAGE SERVICE IN 802.11 MSC AREA
IS-41 SMS-MC
802.11 SERVING MSC
MS
1. SMDPP
2202
4. SMDPP RR
2212
2208
2. SIP INVITE (SMS PAYLOAD)
2204
3. 200 OK
4. SIP BYE
5. 200 OK
2210
2206

FIG. 22

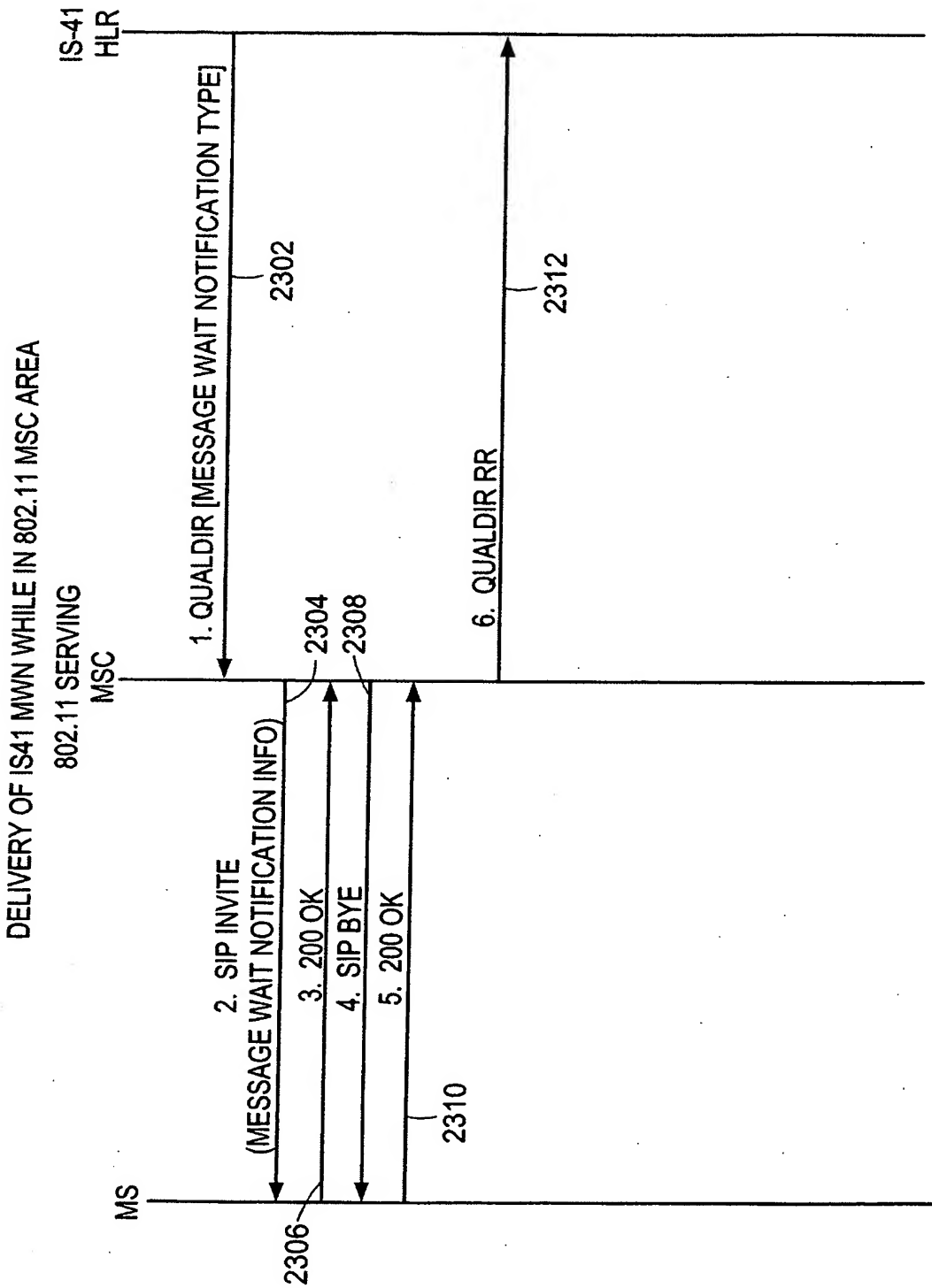

DELIVERY OF IS41 MWN WHILE IN 802.11 MSC AREA
IS-41 HLR
802.11 SERVING MSC
MS
1. QUALDIR [MESSAGE WAIT NOTIFICATION TYPE]
2. SIP INVITE (MESSAGE WAIT NOTIFICATION INFO)
3. 200 OK
4. SIP BYE
5. 200 OK
6. QUALDIR RR
2302
2304
2306
2308
2310
2312

FIG. 23

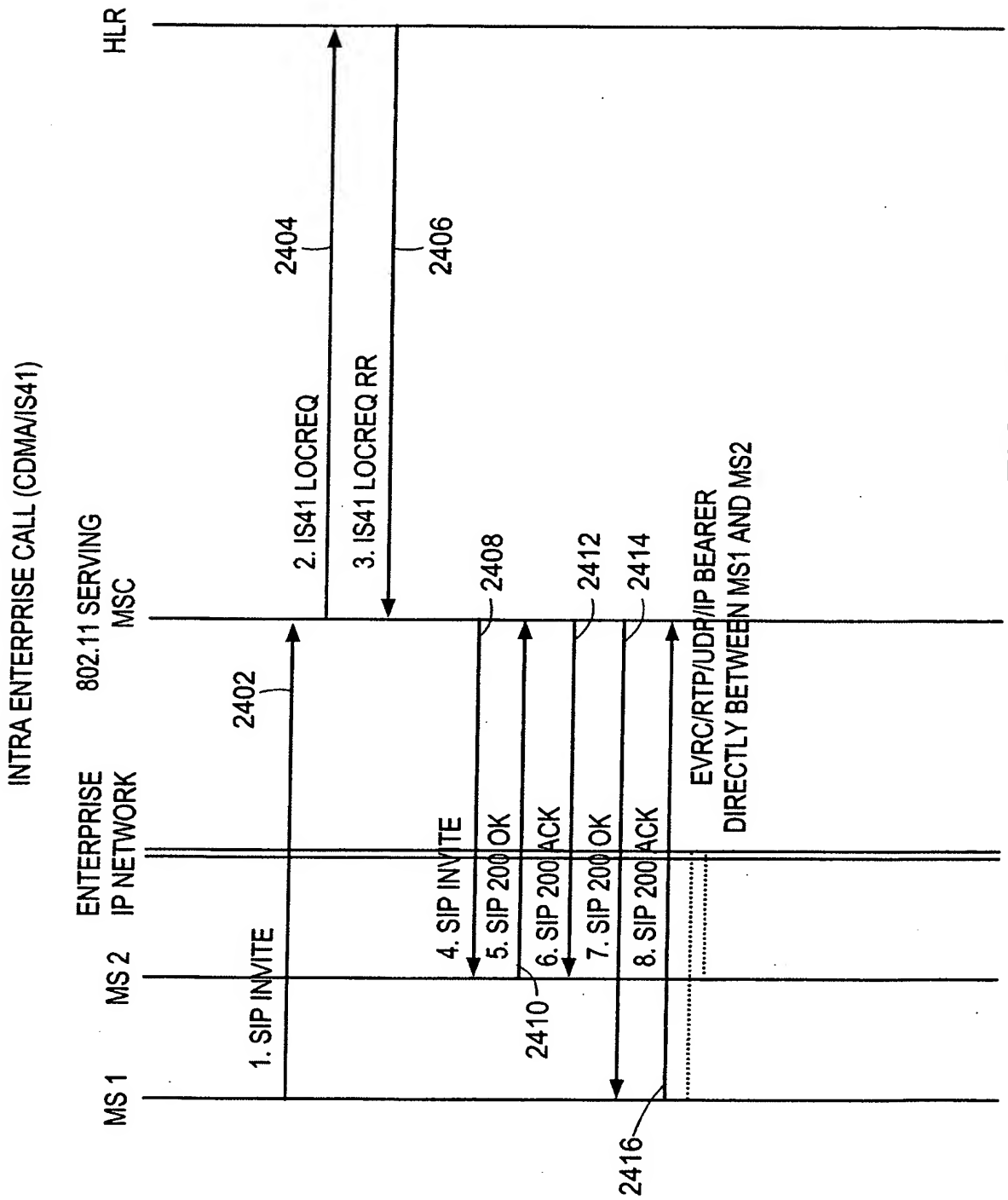

INTRA ENTERPRISE CALL (CDMA/IS41)
MS 1
MS 2
ENTERPRISE IP NETWORK
802.11 SERVING MSC
HLR
1. SIP INVITE
2. IS41 LOCREQ
3. IS41 LOCREQ RR
4. SIP INVITE
5. SIP 200 OK
6. SIP 200 ACK
7. SIP 200 OK
8. SIP 200 ACK
EVRC/RTP/UDP/IP BEARER DIRECTLY BETWEEN MS1 AND MS2
2402
2404
2406
2408
2410
2412
2414
2416

FIG. 24

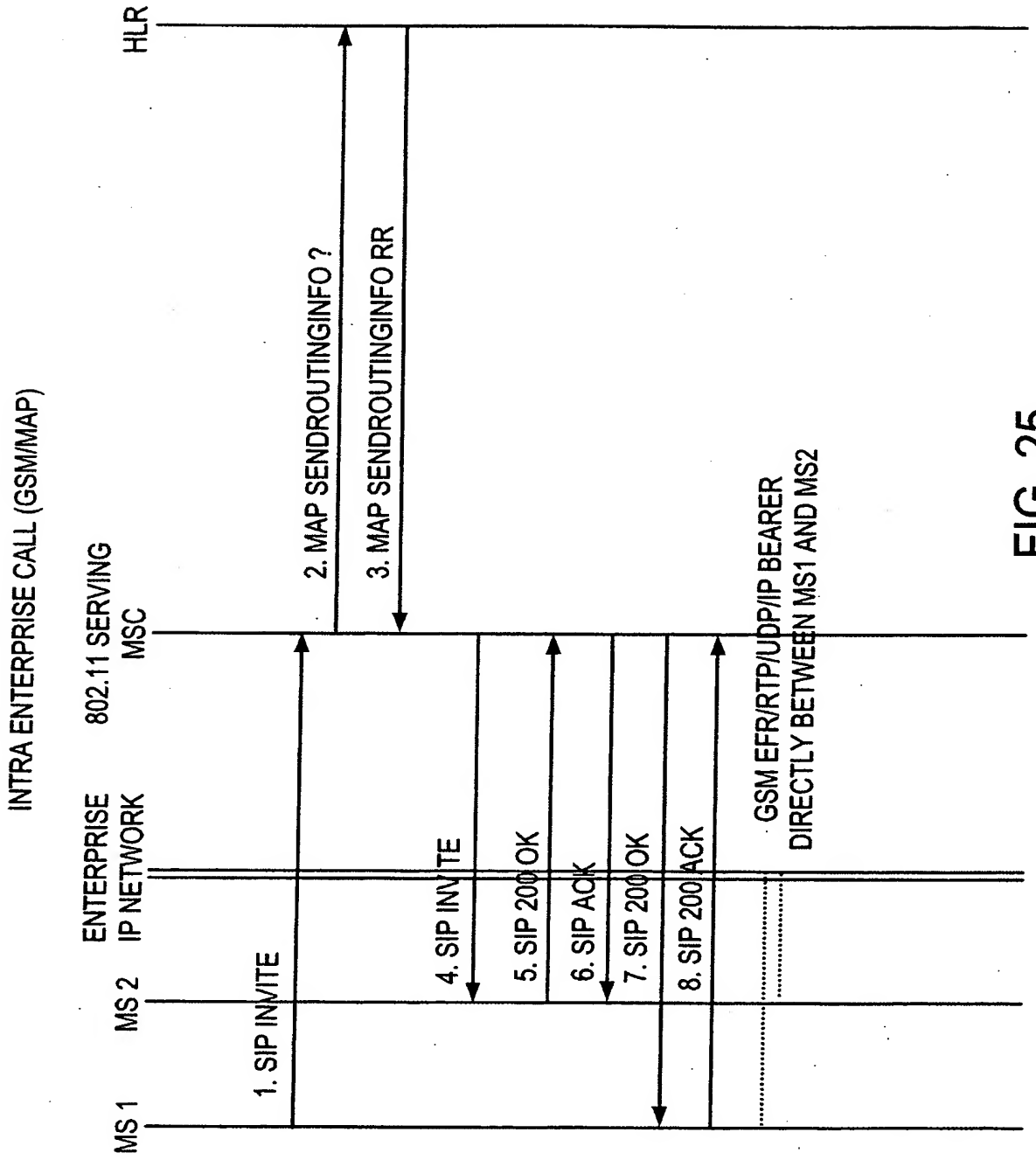

INTRA ENTERPRISE CALL (GSM/MAP)
MS 1
MS 2
ENTERPRISE IP NETWORK
802.11 SERVING MSC
HLR
1. SIP INVITE
2. MAP SENDROUTINGINFO ?
3. MAP SENDROUTINGINFO RR
4. SIP INVITE
5. SIP 200 OK
6. SIP ACK
7. SIP 200 OK
8. SIP 200 ACK
GSM EFR/RTP/UDP/IP BEARER
DIRECTLY BETWEEN MS1 AND MS2

FIG. 25

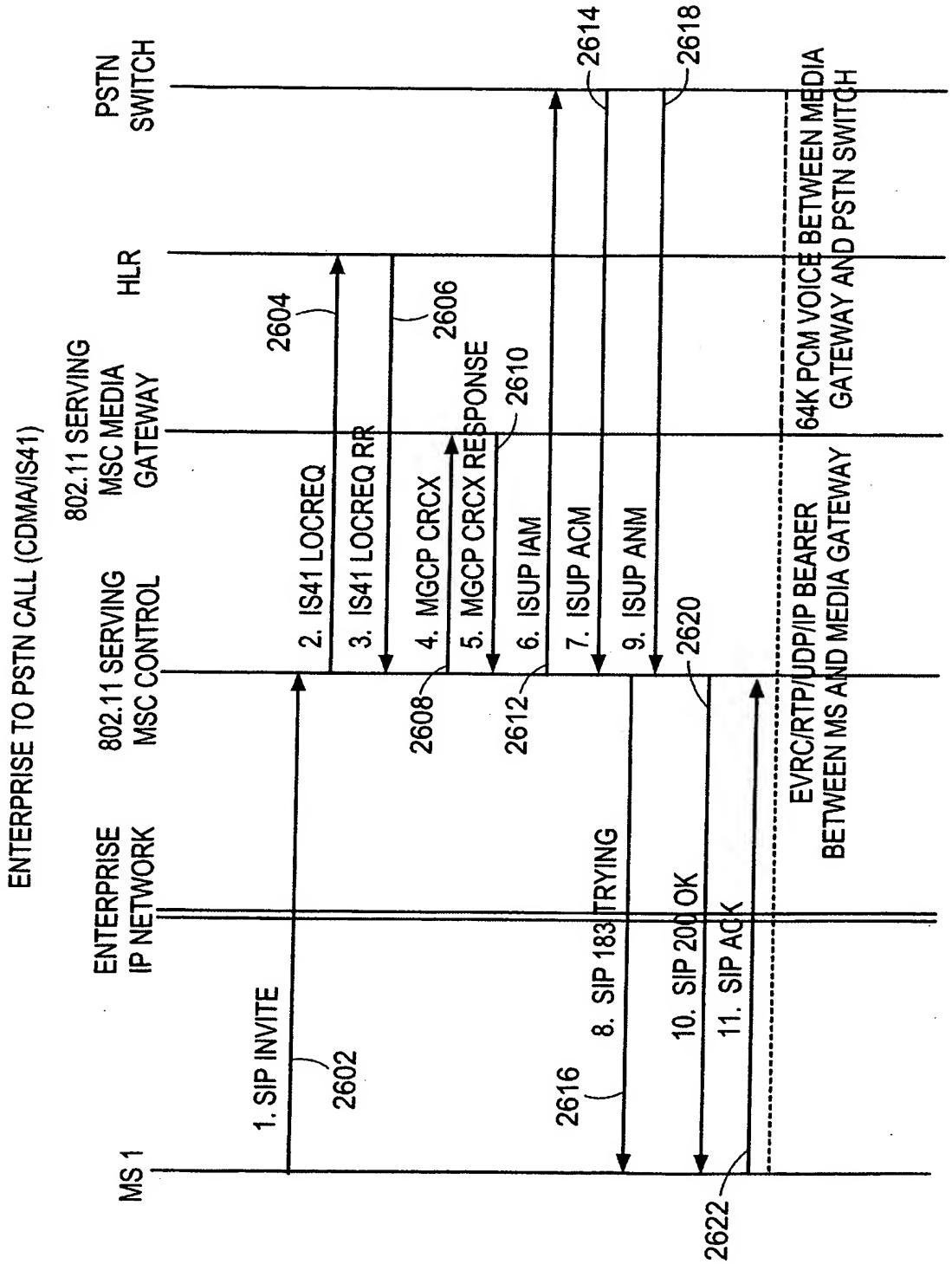

ENTERPRISE TO PSTN CALL (CDMA/IS41)
MS 1
ENTERPRISE IP NETWORK
802.11 SERVING MSC CONTROL
802.11 SERVING MSC MEDIA GATEWAY
HLR
PSTN SWITCH
1. SIP INVITE
2602
2. IS41 LOCREQ
2604
3. IS41 LOCREQ RR
2606
4. MGCP CRCX
2608
5. MGCP CRCX RESPONSE
2610
6. ISUP IAM
2612
7. ISUP ACM
2614
8. SIP 183 TRYING
2616
9. ISUP ANM
2618
10. SIP 200 OK
2620
11. SIP ACK
2622
EVRC/RTP/UDP/IP BEARER BETWEEN MS AND MEDIA GATEWAY
64K PCM VOICE BETWEEN MEDIA GATEWAY AND PSTN SWITCH

FIG. 26

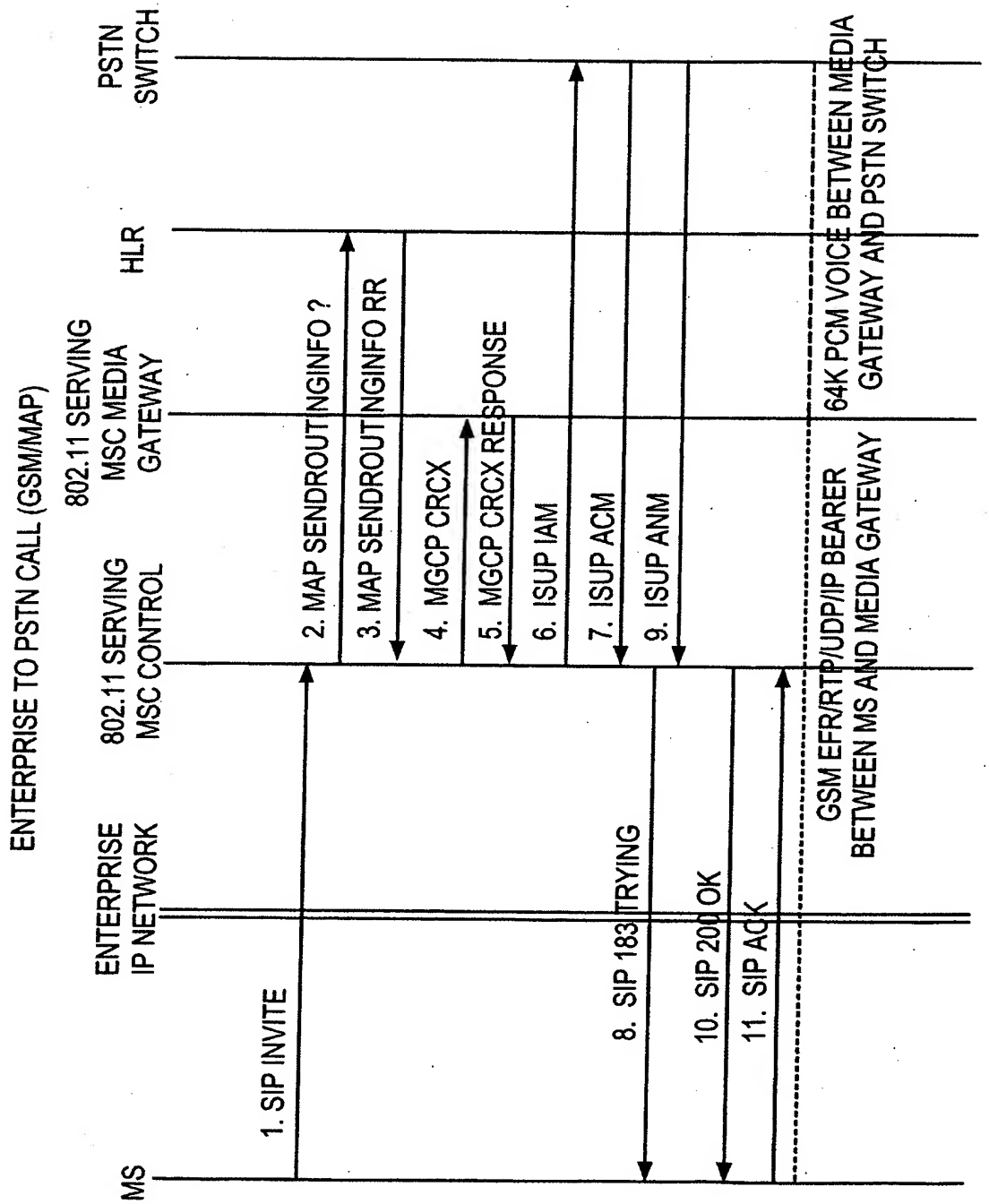

ENTERPRISE TO PSTN CALL (GSM/MAP)
MS
ENTERPRISE IP NETWORK
802.11 SERVING MSC CONTROL
802.11 SERVING MSC MEDIA GATEWAY
HLR
PSTN SWITCH
1. SIP INVITE
2. MAP SENDROUTINGINFO ?
3. MAP SENDROUTINGINFO RR
4. MGCP CRCX
5. MGCP CRCX RESPONSE
6. ISUP IAM
7. ISUP ACM
8. SIP 183 TRYING
9. ISUP ANM
10. SIP 200 OK
11. SIP ACK
GSM EFR/RTP/UDP/IP BEARER BETWEEN MS AND MEDIA GATEWAY
64K PCM VOICE BETWEEN MEDIA GATEWAY AND PSTN SWITCH

FIG. 27

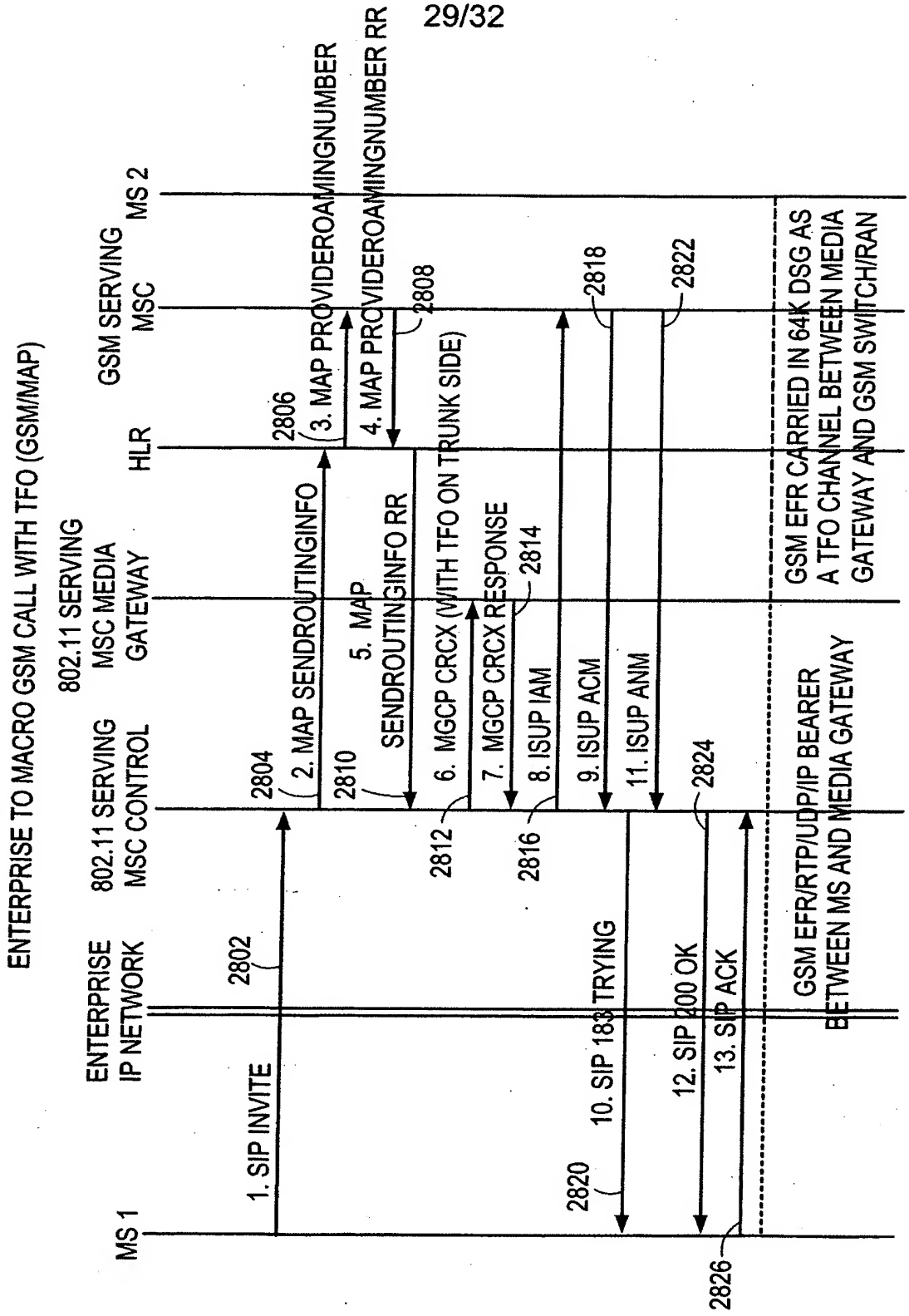

ENTERPRISE TO MACRO GSM CALL WITH TFO (GSM/MAP)
MS 1
ENTERPRISE IP NETWORK
802.11 SERVING MSC CONTROL
802.11 SERVING MSC MEDIA GATEWAY
HLR
GSM SERVING MSC
MS 2
1. SIP INVITE
2802
2804
2. MAP SENDROUTINGINFO
2806
3. MAP PROVIDEROAMINGNUMBER
4. MAP PROVIDEROAMINGNUMBER RR
2808
2810
5. MAP SENDROUTINGINFO RR
2812
6. MGCP CRCX (WITH TFO ON TRUNK SIDE)
7. MGCP CRCX RESPONSE
2814
2816
8. ISUP IAM
9. ISUP ACM
2818
10. SIP 183 TRYING
2820
11. ISUP ANM
2822
12. SIP 200 OK
2824
13. SIP ACK
2826
GSM EFR/RTP/UDP/IP BEARER BETWEEN MS AND MEDIA GATEWAY
GSM EFR CARRIED IN 64K DSG AS A TFO CHANNEL BETWEEN MEDIA GATEWAY AND GSM SWITCH/RAN

FIG. 28

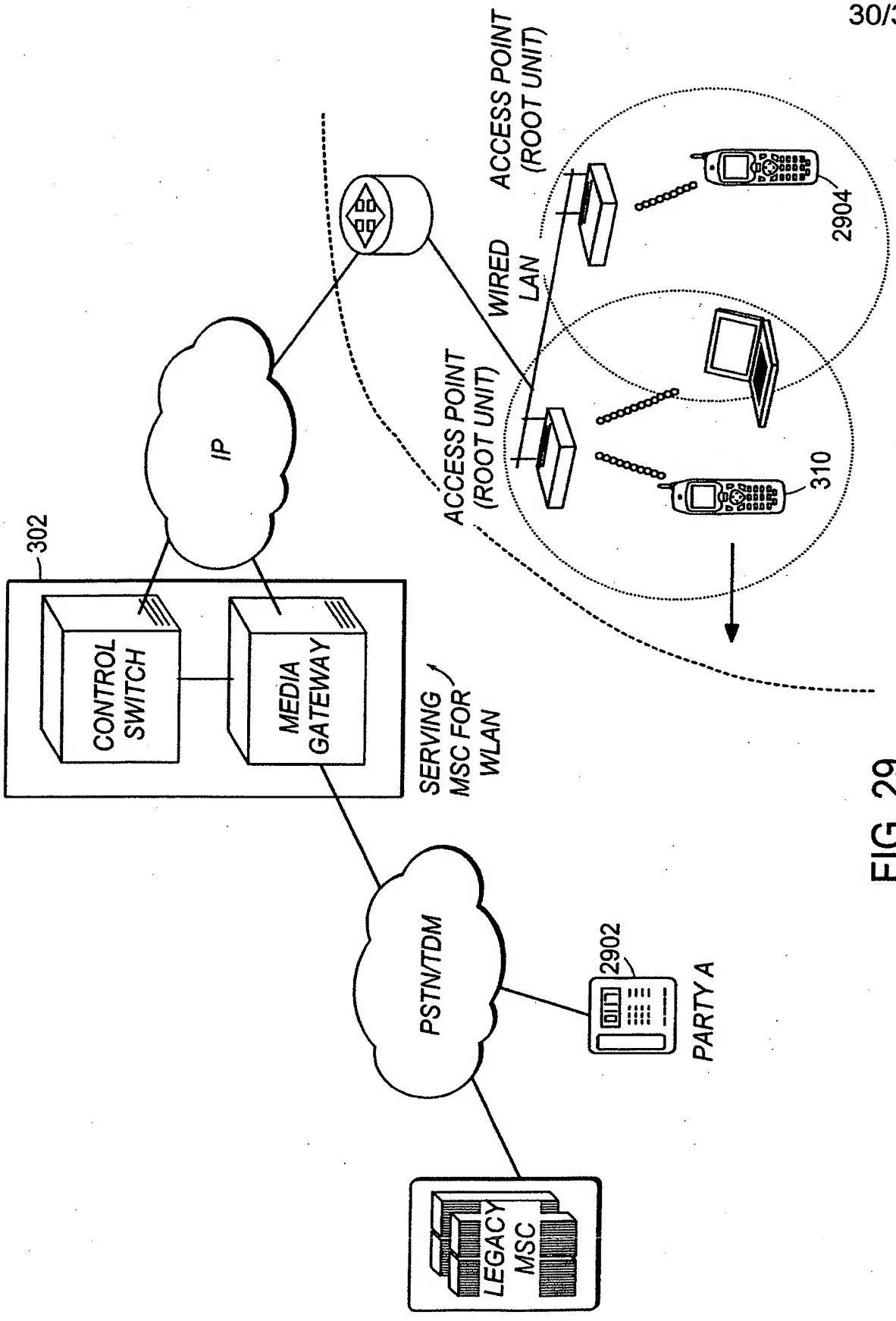

ACCESS POINT
(ROOT UNIT)
WIRED
LAN
2904
IP
ACCESS POINT
(ROOT UNIT)
310
302
CONTROL
SWITCH
MEDIA
GATEWAY
SERVING
MSC FOR
WLAN
PSTN/TDM
2902
PARTY A
LEGACY
MSC

FIG. 29

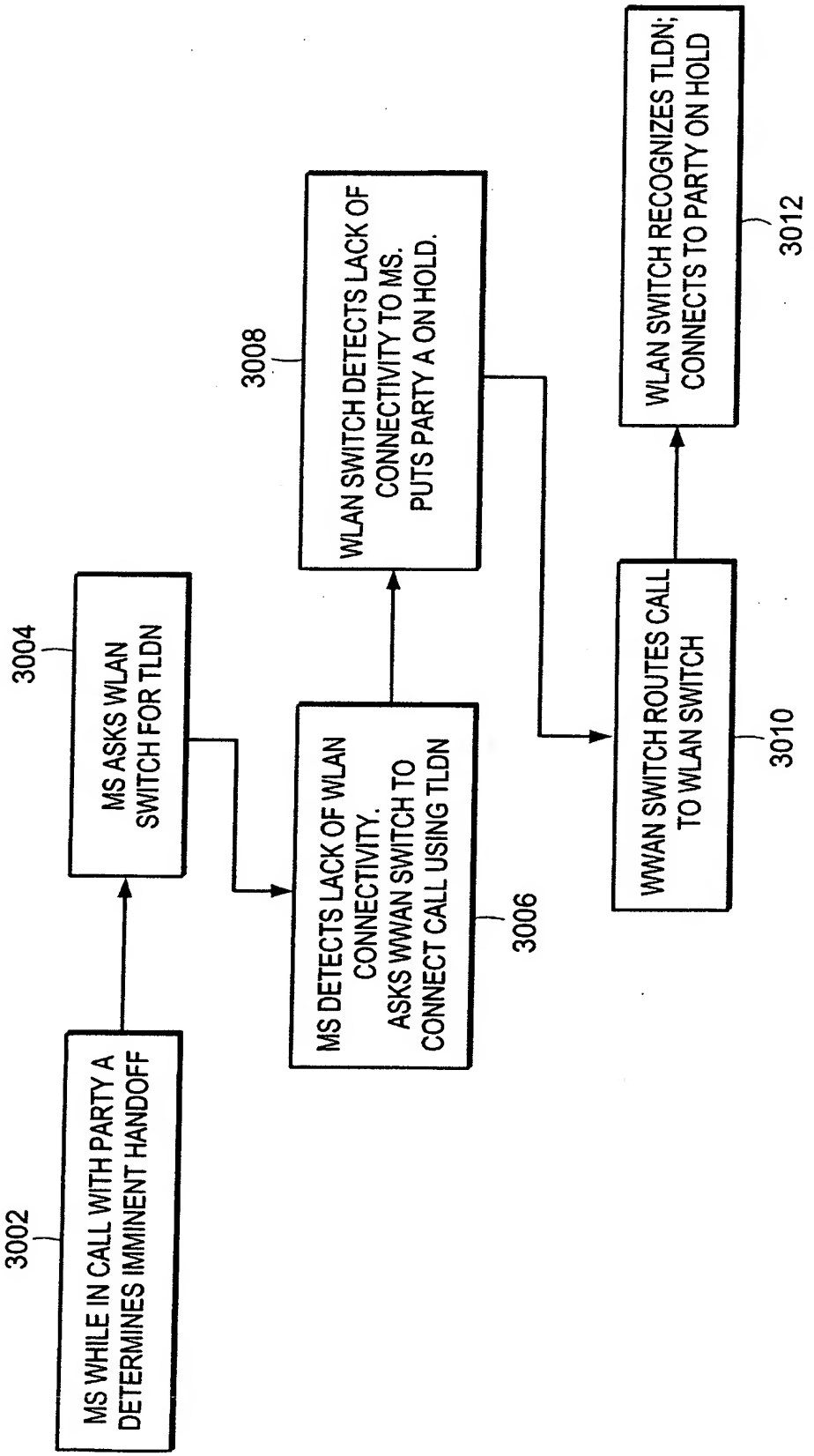

MS WHILE IN CALL WITH PARTY A DETERMINES IMMINENT HANDOFF
3002
MS ASKS WLAN SWITCH FOR TLDN
3004
MS DETECTS LACK OF WLAN CONNECTIVITY. ASKS WWAN SWITCH TO CONNECT CALL USING TLDN
3006
WLAN SWITCH DETECTS LACK OF CONNECTIVITY TO MS. PUTS PARTY A ON HOLD.
3008
WWAN SWITCH ROUTES CALL TO WLAN SWITCH
3010
WLAN SWITCH RECOGNIZES TLDN; CONNECTS TO PARTY ON HOLD
3012

FIG. 30

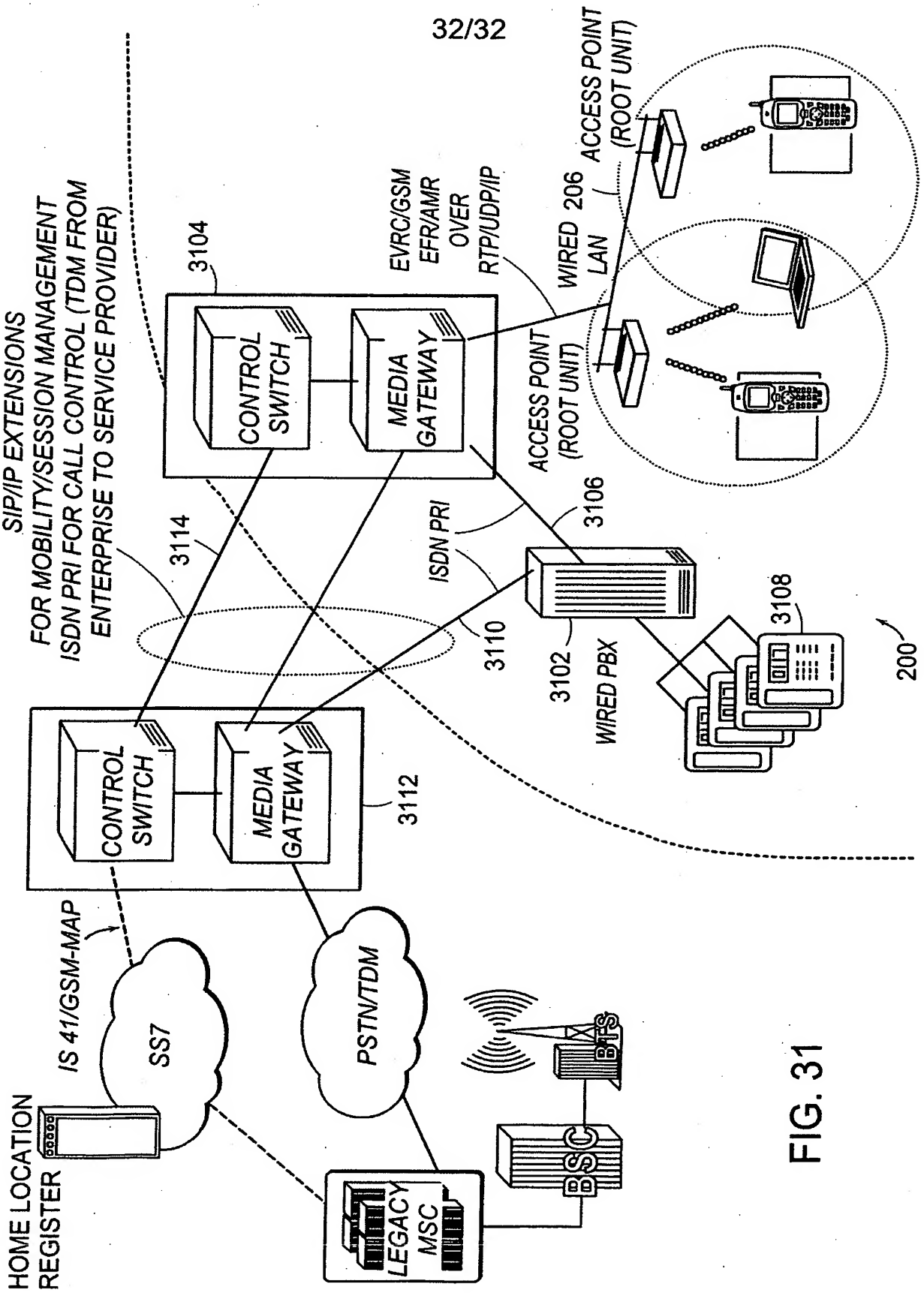

SIP/IP EXTENSIONS
FOR MOBILITY/SESSION MANAGEMENT
ISDN PRI FOR CALL CONTROL (TDM FROM
ENTERPRISE TO SERVICE PROVIDER)
3104
CONTROL SWITCH
MEDIA GATEWAY
EVRC/GSM
EFR/AMR
OVER
RTP/UDP/IP
ACCESS POINT
(ROOT UNIT)
WIRED 206
LAN
ACCESS POINT
(ROOT UNIT)
3114
ISDN PRI
3106
3110
3102
WIRED PBX
3108
200
CONTROL SWITCH
MEDIA GATEWAY
3112
IS 41/GSM-MAP
SS7
PSTN/TDM
HOME LOCATION
REGISTER
LEGACY MSC
BSC
BTS

FIG. 31